NATURE

No. 3869 SATURDAY, DEC. 25, 1943 Vol. 152

CONTENTS

	Page
The Imperial Agricultural Bureaux	731
Library Service in Great Britain	733
The Quantitative Aspect of Physiological Regulations. By Dr. O. A. Trowell	735
History of Cattle Breeding. By G. E. Fussell	736
The Clifton Park System	737
Steric Hindrance and Heats of Formation. By Dr. A. G. Evans and Prof. M. Polanyi	738
The Regional Concept in Geography. By W. Fitzgerald	740
Taxonomy of the Moths Infesting Stored Food Products. By Dr. A. Steven Corbet	742
Obituary: Prof. Isidor Traube. By Dr. D. H. Bangham	743
News and Views	744
Letters to the Editors:	
Flow States in Emergent Gas Streams.—J. E. Garside, A. R. Hall and Prof. D. T. A. Townend	748
Reflecting Microscopes.—Dr. C. R. Burch	748
An Optically Active Selenonium Salt.—Dr. F. G. Mann and F. G. Holliman	749
An Antibacterial Substance from *Aspergillus clavatus* and *Penicillium claviforme* and its Probable Identity with Patulin.—Dr. F. Bergel, A. L. Morrison, A. R. Moss, R. Klein, H. Rinderknecht and J. L. Ward	750
Rate of Growth of Bracken.—Prof. K. W. Braid and Elsie Conway	751
Stimulation of the Milk Production of Dairy Cows by Feeding Thyroid-active Iodinated Proteins.—K. L. Blaxter	752
A Scientific Directory.—Dr. James Walker	752
Research Items	753
The Spanish Iron and Steel Industry	755
Soviet War-time Surgery. By Dr. G. Lapage	756
Utilization of Bamboos in India	756
The Science of Tomato Growing	757
Hydrogen Exchange Reactions	757
Recent Scientific and Technical Books	Supp. ii

Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831
Telegrams: Phusis Lesquare London

Advertisements should be addressed to
T. G. Scott & Son, Ltd., Talbot House, 9 Arundel Street, London, W.C.2
Telephone: Temple Bar 1942

The annual subscription rate is £4 10 0, payable in advance, inland or Abroad.

All rights reserved. Registered as a Newspaper at the General Post Office

THE IMPERIAL AGRICULTURAL BUREAUX

IT is a pleasant occupation in these times, when so much is being talked about imperial and international co-operation, to study the workings of an organization built up by such co-operation, and the Imperial Agricultural Bureaux furnish a very relevant example. They were set up in their present form by the Governments of the British Commonwealth in 1928 on the recommendation of the Imperial Agricultural Research Conference, and the Governments have been sufficiently satisfied with the organization for them to accept the recommendation of the British Commonwealth Scientific Conference of 1936 to increase their number.

The agricultural bureaux were primarily set up to help research workers in the British Empire to keep abreast of their subjects. All research workers know only too well how many publications may contain information of importance to them, how much they would cost if they had to buy them all, and the great diversity of language used. This difficulty is serious enough for a research worker in a large central research institution, but it becomes insuperable in small isolated institutions. The primary function of the bureaux is to lighten the difficulties of research workers in agricultural institutions by various means: by issuing regular abstract journals and bulletins dealing with recent advances in knowledge in specific subjects; by providing information needed on specific points, with the corollary that the workers themselves must be aware of the existence of the bureaux and have sufficient confidence in them to ask for this information; by arranging meetings between research workers whenever sufficient of them can be brought together; and by acting as advisers or host whenever any of them can make use of that service.

The bureaux have thus a very difficult function to fulfil, as they must contain on their staffs men competent to understand the sciences in which advice is wanted. They cannot, therefore, be a staff of mere abstracters, nor simply secretaries to farm out papers to a panel of abstracters. The men must have experience in agricultural research, so that they can appreciate the peculiar difficulties of any particular subject, but it is equally essential that they should keep abreast of all new ideas. Each bureau was set up alongside a leading research station devoted to that science, to help the bureau staff keep their own knowledge up to date, and to allow any specific problem to be rapidly referred to a leading specialist when necessary.

It was also necessary to ensure that the Empire research workers using the bureaux should have accurate knowledge of what the bureaux can do, and confidence in their competence to do it; and it was accepted that personal acquaintance with the bureau itself was the best way of giving them that knowledge. It was mainly for this consideration that the Governments placed all the bureaux in Great Britain, the country visited by the greatest number of Empire workers.

The bureaux were set up by the Governments of the British Commonwealth, who are jointly responsible for their finance. An Executive Council composed of a nominee from each Government contributing to the fund and of a secretary, who is also in fact the secretary to the Imperial Economic Committee, is responsible for their administration. The Council's work was reviewed by the British Commonwealth Scientific Conference in 1936, and a further review should have been made in 1941, but the War prevented this. In consequence the Executive Council set up a committee, under the chairmanship of Lord Hankey*, to undertake this review, adding in the terms of reference the request for it to report on how the activities of the bureaux can be extended to be of greater service to the British Commonwealth, and making the significant statement "and in general to the United Nations". For these agricultural bureaux have no counterpart elsewhere in the world, and although they were set up for the sole purpose of helping agricultural research workers throughout the Empire, their publications have a considerable circulation throughout the world, and their work is sufficiently highly appreciated for them to be frequently consulted by foreign workers.

At the present time the bureaux fall into two categories: those for entomology and mycology, which were already in existence before the Executive Council was set up, and the ten that have been set up since. These two earlier bureaux, set up under previous Imperial Conferences and financed by the several Governments jointly, have a wider function than the others, for they not only abstract the literature but also identify any pathological insect or fungus found in any part of the British Empire. This makes it necessary for them to have trained systematists on their staffs with adequate laboratory accommodation; to signify this wider function their names were changed from Bureaux to Institutes when they were taken over by the Executive Council. The Entomological Institute is equally concerned with plants and animals, as insects are serious pests on both; but fungal diseases are primarily plant diseases and, in consequence, the Mycological Institute has extended in the direction of plant pathology, and now not only covers the fungal diseases proper but also the virus and bacterial diseases as well. But there are fungal diseases of animals and humans, and here Lord Hankey's Committee found that the Institute was in fact abstracting some papers on medical mycology without any clear indication of what use would be made of these abstracts, as the medical profession was apparently unaware of its existence and, in fact, was barely in need of them since the Bureau of Hygiene and Tropical Diseases issued suitable abstracts on many aspects of medical mycology for the profession. Already a sub-committee has been set up under the Medical Research Council to examine the whole question of abstracting these papers, and the much more serious one of ensuring that medical nomenclature is in line with present-day mycological nomenclature.

Originally eight bureaux were set up directly under the Executive Council to deal with the various groups of agricultural sciences, namely, animal health, animal nutrition, animal genetics, soil science, pasture and forage crops, plant genetics, horticulture and agricultural parasitology (helminthology), to which were added, just before the War, dairy science and forestry. All these bureaux deal with specific branches of agricultural science and, on the whole, meet the needs of the scientific research workers admirably, as they themselves are usually working on one or two of these specific sciences. But there is no bureau for general husbandry, a branch of knowledge barely accepted in Great Britain as a part of agricultural science. The Committee recommends setting up such a bureau, a recommendation which surely should be accepted, as it will involve making an extremely interesting experiment that can profitably be watched by the agricultural research institutes in the country. The main field of general husbandry, excluding economics, is in fact covered by the existing bureaux, but their publications are already so voluminous that it is practically impossible for any one person even to skim through their abstract journals. Nor is it any bureau's business to stress those points of importance for the practical farmer.

The proposed bureau would, therefore, largely duplicate work done by the existing bureaux, and by the Bureau of Soil Science in particular, for on the scheme suggested in the report most of the subjects considered suitable for the new bureau fall under crop husbandry, which the Bureau of Soil Science already covers fairly thoroughly. The value of the new bureau would rather lie in its skill in selecting information lying on the borderline between crop and animal husbandry, but it will have to face the supreme difficulty for a bureau that there is very little literature dealing with these borderline subjects owing to their comparative neglect in the development and organization of agricultural research.

One of the greatest benefits a bureau of general husbandry could give to Great Britain is to map out clearly the field of work it can genuinely cover, for once the field has been recognized and defined, the Ministry of Agriculture and the Agricultural Research Council can modify their research policy to allow such a field to be adequately covered. In Great Britain the experimenters in this subject are the progressive farmers, and the descriptions of their methods given in the popular farming journals are usually woefully inadequate for an appreciation of the value and limitations of the work carried out. The bureau might easily have to consider what criteria should be used for judging the value of a method tried out on a farm, and this investigation, in itself, would be one well worth undertaking.

There is a further field of imperial agricultural co-operation which could be profitably developed, namely, that concerned with the making of plant collections of value to the plant breeder, and their preservation when made. The United States and the

* Report on the Imperial Agricultural Bureaux, by a Committee under the Chairmanship of the Rt. Hon. Lord Hankey. Pp. 38. (London: H.M. Stationery Office, 1943.) 1s. net.

U.S.S.R. have each organized many expeditions for the express purpose of making such collections, and just before the War the Executive Council of the Imperial Agricultural Bureaux expanded its scope by financing such an expedition to South and Central America for the collection of wild varieties of potatoes; a collection that may become of outstanding importance, as one of the surprising results of the War has been the way the potato has invaded countries, particularly in the Mediterranean, that barely knew it before, and if this crop is to remain in these countries it will be necessary to raise varieties suited to their conditions.

The development of machinery for ensuring that these collections, once made, are not dispersed is much more difficult, and the Hankey Committee recommends that the Executive Council should interest itself in this problem and be able to furnish the next British Commonwealth Scientific Conference with an accurate picture of the collections in existence. The problem might become urgent at any time, as certain institutions throughout the Empire have already made such collections, and if for any reason one of these institutions had to give up carrying on its collection, or even to reduce it, there is no organization to save the collection from dispersal or loss. These collections obviously are imperial assets, for they may contain wild species of little value at the present time but with characters of great importance for other centres or other times. That such collections are international assets as well, so that this is genuinely a problem for international co-operation, is no excuse for the Governments of the British Empire not setting up a co-operative organization to safeguard such collections wherever they may be.

The creation and preservation of such large living collections of plant species has thus just begun to be a field of imperial co-operation, but, as already stressed, it must also become a field for international co-operation, if for no other reason than that it will be a very potent instrument for raising the standard of living in those countries suffering from chronic malnutrition. Such an organization is, therefore, almost an essential corollary to the 'freedom from want' clause in President Roosevelt's famous four freedoms, and to the relevant sections of the Atlantic Charter and the Hot Springs Conference.

LIBRARY SERVICE IN GREAT BRITAIN

THE detailed report on "The Public Library System of Great Britain" prepared by Mr. L. R. McColvin for the Library Association, which was published in September 1942 (see NATURE, March 20, 1943, p. 317), has now been considered by a special committee of the Library Association appointed by the Council of the Association for that purpose. This committee, after considering the report and comments thereon from branches and sections of the Library Association, public library committees and other interested groups and individuals, has presented its report to the Council; and an official statement of the Association's proposals for the re-organization and development of the public library service of Great Britain has now been issued*. The proposals can thus be fittingly considered against the plan for educational reform now before the nation, with the enhanced demands on the public library service which such reform is likely to stimulate. Equally important, the proposals throw some light on the broad question of local government efficiency and reform, on which opinion is not the less concerned on account of the Government's refusal to consider the matter during the War.

On the latter question, it is unnecessary to remark more than that while the Government may decline to consider local government reform as a whole, we are unlikely, without some definite action, to obtain the improvement in public library services and facilities which is not only desirable but also probably essential if the full advantage of the new educational proposals is to be reaped. Merely to remove the permissive stumbling block in the Acts of Parliament by which public libraries exist will not carry us far when the resources of many local authorities are so small, and an attempt to deal with the regional question alone might well prove an obstacle to subsequent more fundamental reform.

Without recapitulating the conclusions of Mr. McColvin's report, it may be recalled that his survey gave an outstanding impression of generally unsatisfactory provision and of a badly organized service. Even the best administered and supported libraries in Great Britain are still unable to realize the reasonable ideals of their own committees and officers. The wide variations in standards of provision in different areas are depriving many men and women of educational and cultural opportunities which others enjoy. The service is often most defective where it would be most valuable. The permissive principle stands condemned; and many local authorities appear both incompetent as well as inadequately provided with resources so far as library services are concerned.

The Council of the Library Association in its statement follows closely the conclusions of the McColvin report. There are, in its view, four paramount conditions for the development of sound library service throughout Britain. First, the provision of adequate services by suitable library authorities must be made compulsory. Secondly, there must be an appropriate department of the central government responsible for guiding, encouraging and co-ordinating the work of local library authorities and insisting upon their efficiency. Thirdly, all local authorities must be made financially able to attain efficiency; and fourthly, the composition and size of local government areas must be such that the best results are made possible.

In regard to the essential requirements of any system of library service, the statement makes five points. An adequate service must be available to everyone, irrespective of where he may reside, and must include not only reasonable access to appro-

* The Public Library Service: its Post-War Reorganization and Development. Proposals by the Council of the Library Association. Pp. 16. (London: Library Association, 1943.) 6d.

priate service points, but also the right and the opportunity to draw upon whatever wide resources of books and professional services each individual may require. Every accredited person should be enabled freely to borrow books from, or consult books in, any public library, regardless of his place of residence or employment. The library service should be so organized and provided that it can meet all the legitimate requirements of the community for books and information. Libraries must be controlled by library committees of men and women chosen for their interest in the service and their appreciation of its possibilities, and responsible directly to their local authorities. Finally, libraries must be staffed by capable and experienced chief officers with sufficient suitable and qualified assistants.

The Library Association holds, and we think rightly, that the public library is essentially a local service, and one that should be intimately related with, and responsive to, local needs. Nevertheless, it considers that each library authority's area must embrace a socially cohesive unit, a normal natural congregation of people, and be well related to their ways of living, interests and occupations. In general, the population of a library area should be between one quarter and three quarters of a million, and the area will embrace not only the nucleus large town but also all the surrounding area which is closely related culturally and commercially. This, it is recognized, involves reform of local government areas and functions.

Failing the creation of a new Ministry or Government Department concerned with libraries, museums and other cultural matters, the statement urges that the Board of Education should be made responsible for guiding, co-ordinating and encouraging the development of local library services, but that this responsibility should be exercised through a new and distinct library department of the Board. The officers of this department should be appointed specifically for, and engaged solely upon, library matters. Grants to library authorities from the national exchequer will be necessary to make possible the provision of adequate library services throughout the country, but such grants must be made contingent upon the maintenance of sufficient suitable service points, satisfactory expenditure on books, the employment of sufficient and appropriately qualified staff and payment of agreed national scales of salaries for all grades.

According to the McColvin Report, reference library work is the outstanding failure of librarianship in Great Britain. The Association's statement proposes that a limited number of existing large reference libraries should be specially developed as regional reference libraries. All local authorities should maintain suitable special collections which would form centres for information and bibliography in their respective special spheres for the benefit of the whole country. The National Central Library should be strengthened and developed, and fully supported by adequate grants from national funds, to provide an efficient system for the interchange of the more specialized, older and less readily obtainable material. Both local provision and more comprehensive book-stocks should reduce other inter-library lending to a minimum, but the National Central Library should maintain the appropriate union catalogues, develop and maintain co-operation between libraries of all kinds, encourage and co-ordinate the development of special libraries, act as a national centre for bibliographical information, organize international loans, and act as a centre and clearing-house for bibliographical information regarding the literature of foreign countries. The cataloguing of books and the provision of necessary bibliographical assistance for readers and library staffs should be undertaken on a national basis by a central cataloguing department which could appropriately be part of, or closely associated with, the National Central Library.

Passing over the detailed discussion of the question of qualified staff, the general argument of which should be assured of the support of scientific workers, we note that an adequate and efficient public library service is regarded by the Library Association as a necessary background to any scheme of adult education. The public library is not to be regarded primarily as a part of the formal educational machinery, and its place in the community is well indicated in this section of the statement. Welcome emphasis is laid on the importance of relating the public library service as closely as possible to all other types of libraries, such as those of universities, government departments, scientific and research institutions, etc., and the national libraries. It may well be hoped that the attention now being given to rehabilitation and reconstruction of libraries all over Europe may lead to more attention being given to the fundamental problems of library co-operation and relations between special and general collections. The War has clearly stimulated closer co-operation, but it should be remembered that inter-library loans are expensive and intrinsically inefficient. Our object should be to create the conditions in which such loans are reduced to the minimum.

There can be no doubt that the Library Association is right in its affirmation that post-war Britain will need and demand a better library service than has yet been fully envisaged by local or national authorities. It will be remembered that in "Redbrick University", Bruce Truscot stresses the importance of the university library in stimulating thought in undergraduates. Development and expansion of the university libraries to meet the post-war situation can scarcely be entirely without reference to the reorganization and development of the reference library system, or to the special libraries, if only because of the difficulties and problems in the distribution and replacement of stocks, particularly of scientific and technical periodicals and the like, to which some reference was made at the recent conference held by the Association of Special Libraries and Information Bureaux. The Library Association thus covers ground of the closest interest to scientific workers, and their support as citizens should be assured for the thorough revision of the law relating to public libraries required to implement the proposals of the Association.

THE QUANTITATIVE ASPECT OF PHYSIOLOGICAL REGULATIONS

Physiological Regulations
By Prof. Edward F. Adolph. Pp. xvi+502. (Lancaster, Pa.: Jaques Cattell Press, 1943.) 7.50 dollars.

THE maintenance of relatively constant internal conditions in the face of a fluctuating external environment is perhaps the most characteristic feature of living, as opposed to non-living, systems. Such constancy, however, is only achieved and maintained by active regulatory processes on the part of the animal itself, and an animal only survives in so far as its 'physiological regulations' are competent to oppose and nullify any threatened change in its internal state. All physiological processes, with the exception of reproduction, appear, in the long run, to be devoted to this end; and the physiologist has come to define life as a perfectly integrated series of physiological regulations.

While the existence of physiological regulations has been apparent to everyone, and the physiological machinery by which they operate has, to some extent, been dismembered and examined, there has so far been little or no quantitative study of regulations as such. Prof. E. F. Adolph, in the United States, inspired by the pioneer work of J. S. Haldane and L. J. Henderson, has devoted many years to the measurement of physiological regulations, and his methods, results and ensuing philosophy are now available in this large monograph.

To most physiologists the study of a physiological regulation would imply an inquiry into the machinery —the organs, nerves, hormones and so on—involved. We may say at once that there is nothing of this in Adolph's book. His concern, as he clearly defines, is simply to measure the speed, sensitivity and range of regulatory processes without any consideration of the anatomical and physiological mechanisms by which they are effected. In short, he is interested in what the animal does, but not in how it does it. In general terms, his method is as follows. Any bodily factor which is subject to regulation is called a "component". Components are of diverse kinds; there are chemical constituents, such as water, glucose, oxygen; there are physical constituents, such as heat; there are activities, such as heart-rate. In the case of most components there is a continual turnover during life, and the total content of component is regulated by a balanced adjustment of the rates of gain and loss. The requisite data concerning the regulation of any given component are obtained in the following way. An increase or decrease in the total content of the component is produced by experimental means; this increment is called the "load" and it may be positive or negative. Having established a measured load, the time-course of the recovery process (regulation) is followed by determining the total content at intervals until it returns to normal; if possible the coincident changes in the rates of gain and loss are also followed. These measurements, repeated over as wide a range of loads as the animal will tolerate, provide all the data that are required. From the data a number of correlations can be established between the various variables.

Although some eight or nine different correlations were found to have their individual uses, two of them seem to be of particular value in assessing and characterizing the regulation; they are the equilibration diagram and the velocity quotient. The equilibration diagram is a graph plotting (*a*) rate of gain of component, and (*b*) rate of loss of component, against load. Zero load is placed in the centre of the abscissa and positive and negative loads extend out on either side respectively. At zero load the component is "in balance", rate of gain equals rate of loss, and hence the gain and loss curves always intersect at this point. If gain and loss cannot be separately ascertained, then rate of total change is plotted against load. It turns out that rate of gain and rate of loss are more or less directly proportional to load, though the proportionality is different as between gain and loss and as between positive and negative loads. In other words, the curves of the equilibration diagram tend to be straight lines radiating at different slopes from the point of intersection at zero load. In each case the steeper the slope the more prompt and sensitive is the regulatory process which it represents. The slope of the curve is given by the ratio rate over load; this ratio is the "velocity quotient", and it is a useful unidimensional measure for the efficiencies of the several regulatory processes concerned in the total regulation. The quantities concerned are measured in physiological units, as percentages of the initial total content, so that the equilibration diagrams and velocity quotients in different individuals, in different species, and even of different components, are all directly comparable.

Having thus shown the regulation at work and quantitatively characterized it, Adolph prefers to leave it at that, believing that any inquiry into underlying physiological mechanisms leads to theories of causation which hamper the honest straightforward assessment of the regulation *qua* regulation. In fact he is opposed to any discussion of causation in this connexion, arguing that any consideration of how an animal does things leads to preconceived ideas as to what it ought to do in certain experimental circumstances, and this limits, and may even distort, observation of what it actually does do.

Two thirds of the book is devoted to an exhaustive account of the regulation of the water-content of the body. Water is taken by Adolph as a type component to illustrate his methods in detail; it must therefore be dealt with fully, but, even so, much of the discussion (not the data) in this section could have been condensed; there is much needless repetition and interest flags (to be revived in later chapters).

The methods devised for water are then applied to other components—heat, glucose, lactate, carbon dioxide, oxygen, heart-rate, blood pressure—and are even stretched to cover tissue repair and nervous excitability. Equilibration diagrams are constructed for all these components; the data are mostly taken from the published work of others, the only novelty of the author's method lying in the handling of the data.

The general outcome is that the qualitative pattern of regulation is the same for all components, namely, by appropriate adjustments of the rates of intake or output or both. Indeed, given a turnover, it is difficult to see how it could be otherwise. Adolph makes much of the fact that the general pattern of regulation is always the same, even though the components studied are such diverse entities as water, heat and heart-rate, and even though the physiological mechanisms employed may be totally different in different species. Here one may remark that if, as he insists, the investigation is to be confined to the

overall response of the whole animal, with no consideration of the internal mechanisms involved, then it is scarcely surprising that only a broad and all-embracing pattern can be discovered. There are, of course, marked quantitative differences in the regulations of different components, and of the same component in different species. There are many interesting details to be found here, too numerous to mention; a large number of previously recorded but scattered and forgotten facts are brought together in a new context.

Thus it is interesting to note that, on the basis of quantitative difference, 121 different patterns of equilibration diagram are theoretically possible, but only twenty-five of these are compatible with recovery (regulation), and, of these, only six have been found in operation among the various components and species so far studied. So there are nineteen which may yet turn up. With regard to species differences, it is found that if in any one species the equilibration diagrams for the different components are collected together, they form a pattern which serves to characterize the species. Such physiological characterization of species is no less real than the usual morphological characterization; indeed, it may prove more sensitive in certain instances, and it opens up a new line of thought in comparative physiology.

The most interesting chapter in the book is that on the "Interrelation of Components". Here we study the effect of varying (loading) two or more components at once, and also the effect which loading of one component has on the regulations of other components. Now, the equilibration diagrams of several different components are plotted together on a common set of physiological co-ordinates and we see something quite new—we see the beginnings of a map which would show the integration of the whole animal. This simultaneous handling of different components on one map is perhaps the most important outcome of Prof. Adolph's methods; one has a feeling, for the first time, of getting to grips in a quantitative way with that elusive kernel of physiology—integration. We all know it exists, but now we can begin to measure it, and "science is measurement". Owing to the limited data available only a small field has so far been mapped; but the general picture of integration which emerges is that of a network of interrelated components forming a stress-strain system which is complete in itself. Integration is not some master control superimposed on the observed phenomena; it is just the total map of all the correlations observed. The individual regulations are remarkable enough in themselves, but it is their mutual compatibility which is amazing, and, one may say, the riddle of life.

As already mentioned, in the study of regulations, Prof. Adolph is opposed to any discussion of causation on the ground that it limits inquiry. Many will cross swords with him here, and some may take exception to his somewhat deprecatory references to the "cause-seekers", who must include most present-day physiologists. Cause-seeking he looks upon as the "original sin" of physiologists; it leads to the "accumulation of a body of qualitative facts about which are built up projected or extrapolated aphorisms". He believes that existing data can yield new and significant correlations when handled by his methods, such correlations having hitherto been overlooked simply because observers have, on the whole, only looked for the particular correlations which were suggested by the existing theories. He believes that further knowledge of regulations and integration can best be sought by collecting all the possible data concerning the body and making all the possible correlations, in advance of theoretical speculation.

This point of view, though alien to the classical traditions of physiology, is quite justifiable. There is nothing against it; the only criterion will be—Does it yield worth-while results? It is too soon to say. With regard to the regulation of individual components, nothing very new has emerged; known phenomena have simply been made quantitative; but with regard to the interrelation of components and the integration of the whole animal, there does seem to be in his methods the germ of a new and fruitful line of attack. Integration, that most obscure and yet most fundamental aspect of physiology, certainly calls for new methods and a new attack; present methods have yielded little and they are for the most part exhausted. A great deal of the quantitative data amassed by physiologists for diverse reasons can be re-examined in the light of regulations and analysed by Prof. Adolph's methods. Many workers will find it possible to apply this analysis to the data of their own researches, and it may lead to a new and probably broader view of their problems.

The book does not make easy reading. It is a difficult subject, of course, but often it seems that an unnecessary obscurity has crept in through too much reliance on abstract terms. The 186 graphic figures are excellent and are a sheet anchor to the persevering reader. The author sums up his work quite fairly as "an attempt to formulate and represent quantitatively many notions relative to regulations that are vaguely and partially present in the minds of all physiologists".

O. A. TROWELL.

HISTORY OF CATTLE BREEDING

American Dairy Cattle

Their Past and Future. By E. Parmalee Prentice; with Chapters on Dairy Cattle in America, by Ernest L. Anthony, Lloyd Burlingham, Clifford L. Clevenger, Clifford T. Conklin, Lynn Copeland, Herbert P. Davis, Rockefeller Prentice and Edwin G. Woodward. Pp. xix+453+51 plates. (New York and London: Harper and Brothers, 1942.) 3 dollars.

CLAIMS have been made that certain American breeds of dairy cattle are of immemorial antiquity in their modern form. These claims are set out in herd books, the earliest of which were published in America, and even in publications having the *cachet* of the U.S. Department of Agriculture. History cannot substantiate these claims, and Mr. Parmalee Prentice has successfully demolished them by his careful examination of the evidence and this record of his conclusions.

Since all the cattle in America are descendants of European immigrants, he has been forced to cover a wide field, and, in this connexion, it will be recalled that British breeds of cattle as we know them are of quite recent origin. The first great British breeder was Bakewell (1725–95) and he worked with long-horn cattle, a breed now almost extinct in Britain. What his system was is not known, but it was undoubtedly based upon mating the best with the best in the terms of that day's judgment, and rigorous

culling of the offspring that failed to reach the required standard.

From Bakewell's day onwards cattle breeding was in favour among great and wealthy landowners as well as rich tenants of large farms, because the old open-field system had been superseded by enclosed farms, and control of mating was possible. Formerly, as Lord Ernle succinctly puts it, for at least ten centuries "stock breeding, as applied to both cattle and sheep, was the haphazard union of nobody's son with everybody's daughter", and even in the great age of breeding, say 1770–1870, an infinity of crosses was tried. Almost every so-called breed was crossed with almost every other: Devon with Hereford, Hereford with Shorthorn, Shorthorn with anything and everything, Devon with Sussex and so *ad infinitum*. Few, if any, of the British breeds can claim that its contemporary external characters are more than a hundred and fifty years old; most are much less than a century, and the British dairy-breed herd books are more recent still: Jersey 1883, Ayrshire 1878, Guernsey 1885, British Friesian 1912.

It is on the foundation of such facts as these that Mr. Prentice bases his onslaught on the conception of 'pure bred' breeds of cattle. The old principle that 'like begets like' is a fallacy, for brothers and sisters vary widely, and this is no safe rule to breed by. Again, he holds that the mating of high-producing cows to sons of high-producing cows is likely to lead to failure. In place of this system he suggests the use of the Mount Hope index. This implies that the milk and butter-fat must be recorded every year for every daughter and every mate of a given bull, and that the inheritance the bull transmits is found by comparing the average production of all the bull's mates with the average production of all his daughters.

Mr. Prentice's history is stimulating. His criticism of breeding methods is equally so, and his demand that the Mount Hope index, which is based upon performance and not upon type and pedigree, should be used is certainly one that deserves careful consideration; although as Prof. H. G. Robinson has pertinently remarked, "If the bull is regarded as being at least half the herd, the cow shapes the destiny of her own progeny. . . . A good bull deserves good cows."

G. E. FUSSELL.

THE CLIFTON PARK SYSTEM

The Clifton Park System of Farming and Laying Down Land to Grass

A Guide to Landlords, Tenants and Land Legislators. By Robert H. Elliot. Fifth edition. Pp. 261+8 plates. (London: Faber and Faber, Ltd., 1943.) 12*s*. 6*d*. net.

THIS is a new edition of a book long out of print but well known to agriculturists in the early years of the present century. It was no ordinary volume on grassland management, much less a text-book. It was a book with a purpose, namely, to bring to the notice of farmers, landlords, and if possible the administrators, the merits of a certain system of farming as a means of meeting the prevailing agricultural conditions. The interest of the book to present-day readers lies not so much in the detailed methods adopted by Elliot in the field, but rather in light shed on the agricultural problems of the closing years of the nineteenth century and the picture it gives of a man of highly independent mind striving to influence his fellow farmers with rather less than no support from official sources. Indeed the Board of Agriculture and the newly formed agricultural colleges were supporting the "fertilizer and feeding stuff" approach to farming, which in Elliot's view would be largely unnecessary under a rational system of grassland management.

R. H. Elliot, after a period spent as a coffee planter in India, returned to his property at Clifton Park in Roxburghshire and devoted more than thirty years to developing and demonstrating on his farm an alternate husbandry of four-year leys followed by four arable crops for livestock. In this he saw a method of reducing costs, maintaining and improving soil fertility, and increasing the output of the land. This rotation differed from those usually employed at the time in several respects: the grass was left down longer before being ploughed up, the quality of the grass and clover seeds was very much better than was commonly attained at that time, certain species of plants chosen for their deep rooting and drought-resisting habits were included in the seed mixtures.

As a planter and later as a landlord, Elliot was much impressed by the results of soil exhaustion, which he rightly viewed as a matter of the greatest national consequence. He had no faith in artificials as a remedy, and argued eloquently in favour of organic matter coupled with nitrogen derived from legumes as the basis of soil fertility. These could be obtained most cheaply from good grass well stocked, and each time the land was so treated the results improved. As fertility rose the dependence on artificials and concentrated stock foods steadily diminished, as the results of his farming operations showed.

In the course of his work Elliot raised many points of grassland husbandry that called for research for their final solution. This research was not at the time forthcoming. Many of his ideas have stood the test of time; late-flowering red clover, for example, regarded by him as the mainstay of his leys, still maintains its reputation. In his condemnation of rye-grass he was perhaps too sweeping, as improved strains of this grass have abundantly justified themselves on the more fertile soils. His deep-rooting plants on which he counted so much for opening up poor thin soils are not widely included in present-day mixtures, although their good points for certain conditions are admitted. Other pasture plants, notably wild white clover, scarcely mentioned by Elliot, who sowed the ordinary Dutch clover, have had a most profound influence in the productivity of grassland.

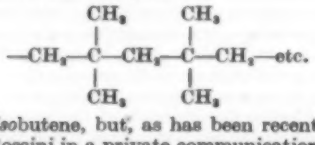
Many of Elliot's proposals which had little support in his time came to pass later. The trade in agricultural seeds has been greatly improved by the Seeds Act 1920 and the resulting activities of the Seed Testing Station at Cambridge. Experimental work on herbage plants and grassland problems has developed in a variety and to an extent that he could not possibly have foreseen, though undoubtedly he would greatly have welcomed them. Agricultural education has left its mark on the farming community, and Elliot's dictum that, "It is well known that, with but few exceptions, agriculturists will not read, and are indeed averse to any form of intellectual exertion" is much less true now than it may have been.

The book gains greatly for modern readers by an excellent preface by Sir George Stapledon, who gives it the necessary orientation in relation to subsequent grassland developments.

STERIC HINDRANCE AND HEATS OF FORMATION

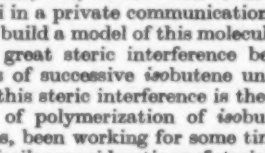
By DR. A. G. EVANS and PROF. M. POLANYI
University of Manchester

IN the low-temperature polymerization of isobutene by boron fluoride, BF_3, the heat of polymerization, which has been found to be in the neighbourhood of 10 kcal. per mole, is lower than would be expected on the basis of theoretical calculations[1]. Both chemical[1] and X-ray[2] evidence support the head-to-tail chain-structure :



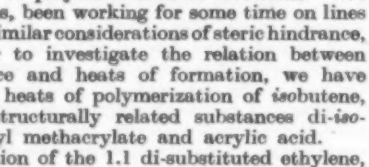
for poly*iso*butene, but, as has been recently pointed out by Rossini in a private communication to Flory[3], an attempt to build a model of this molecule indicates that there is great steric interference between the methyl groups of successive *iso*butene units. Flory suggests that this steric interference is the reason for the low heat of polymerization of *iso*butene. We have, ourselves, been working for some time on lines suggested by similar considerations of steric hindrance, and, in order to investigate the relation between such hindrance and heats of formation, we have measured the heats of polymerization of *iso*butene, and of the structurally related substances di-*iso*butene, methyl methacrylate and acrylic acid.

Polymerization of the 1.1 di-substituted ethylene, $CX_1X_2 = CH_2$ can lead to a head-to-tail structure :



(*a*)

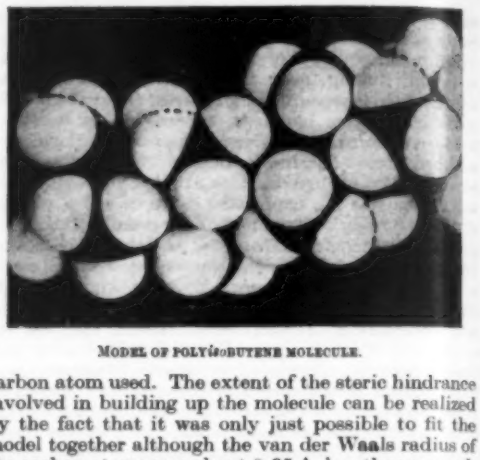
or to a head-to-head, tail-to-tail structure :



(*b*)

or to a mixed structure containing both these types. Models of these two structures were built for poly-*iso*butene ; that is, when X_1 and X_2 are CH_3 groups.

In the poly*iso*butene molecule of head-to-tail structure (*a*), it was found that the steric interference between the methyl groups was so great that in order to build a model of the molecule, successive *iso*butene units had to be rotated with respect to each other so that the methyl group of one *iso*butene unit fitted in between the two methyl groups of the next *iso*butene unit, as seen in the accompanying photograph of a model. In this way the molecule assumed a spiral configuration, and was found to be quite rigid owing to the close interlocking of the methyl groups. In the Fisher-Stuart models used, the covalent radii of the hydrogen and carbon atoms and the van der Waals radius of the hydrogen atom had their usually assumed values[4]. The van der Waals radius of the carbon atom was 1·35 A. The observed van der Waals radius of carbon is about 1·85 A. in aromatic molecules and 1·7 A. in graphite[4]. Using the rule derived by Pauling[4] that the van der Waals radius is equal to the covalent radius plus 0·8 A. gives a value of 1·57 A. All these values are greater than the van der Waals radius of the model



MODEL OF POLY*iso*BUTENE MOLECULE.

carbon atom used. The extent of the steric hindrance involved in building up the molecule can be realized by the fact that it was only just possible to fit the model together although the van der Waals radius of the carbon atoms was about 0·35 A. less than normal.

When the poly*iso*butene molecule was built according to the head-to-head, tail-to-tail structure (*b*), it was found that no steric hindrance occurred. Furthermore, when the monomer was a monosubstituted ethylene (that is, X_2 was H) both types of polymer molecule were found to be free from steric hindrance.

Thus, for any 1.1 disubstituted ethylene, we should expect the heat of formation of the head-to-tail polymer of type (*a*) to be less than the normal value owing to steric hindrance. For monosubstituted ethylenes, on the other hand, the heat of formation of both types of polymer should be normal ; and the same should be true in general for 1.2 disubstituted ethylenes.

The heat of formation of a polymer such as polythene or poly*iso*butene can be calculated from rules derived from data of Rossini and Kistiakowsky on the heats of formation and hydrogenation of the lower hydrocarbons. The heats of polymerization of various monomers have been calculated in this way by Flory[5]. These heats of polymerization calculated from data on the lower hydrocarbons, where no steric hindrance exists, refer to polymer molecules which are *ex hypothesi* sterically unstrained. In this way, using the more recent heats of formation obtained by Rossini[6], we have re-calculated the heat of polymerization of gaseous *iso*butene to a sterically unstrained gaseous poly*iso*butene as 21·4 kcal. per mole. If we assume that the latent heat of vaporization per gm. and the heat of solution per gm. are the same for the polymer as for the monomer, then the heat of polymerization of liquid *iso*butene to liquid poly*iso*butene, and the heat of polymerization of *iso*butene in solution, will also be 21·4 kcal. per mole in the absence of steric hindrance.

The heat of formation of liquid poly*iso*butene from the elements has been determined experimentally[7]. From this value and the heat of formation of liquid *iso*butene (as calculated from the heat of formation of *iso*butane[8] and the heat of hydrogenation of *iso*butene[9], and the latent heat of vaporization of *iso*butene), we have calculated the heat of polymerization of liquid *iso*butene to liquid poly*iso*butene as 11·5 kcal. per mole. We have measured the heat of polymerization of *iso*butene in solution. The results gave an average value of 12·8 kcal. per mole. In view of the inaccuracy of the heats of combustion involved in Richardson and Parks' value, the agreement between

these two values is sufficient, and justifies our assumption that the heats of solution per gm. of *iso*butene and poly*iso*butene are the same. Both these experimental values for the heat of polymerization of *iso*butene are some 9 kcal. per mole less than the value of 21·4 kcal. which would be expected in the absence of steric hindrance in the polymer.

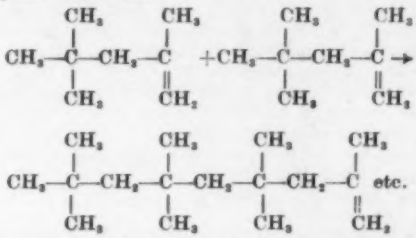
We have calculated the heat of polymerization of gaseous isoprene to a sterically unstrained polymer molecule as 18·7 kcal. per mole. The experimental value for the heat of polymerization has been determined as 17·9 kcal. per mole[10]. The agreement between these two values confirms the expected absence of steric hindrance in the polymer molecule.

For the monomer $CH_2{=}CX_1{=}CH_2$ we expect the steric hindrance of the polymer of structure (*a*) to be greatly increased when X_1 is changed from CH_3 to C_2H_5. When X_1 is *s*-propyl, *t*-butyl, or neopentyl we expect the large steric hindrance involved to make polymerization impossible. We see a confirmation of this last point in our observation, discussed below, that di-*iso*butene, in which X_1 is neopentyl, forms only a dimer under conditions which lead to polymerization of *iso*butene (the action of boron fluoride at room temperature or lower temperatures).

When X_1 is $COOCH_3$, or C_6H_5 (that is, when the monomer is methyl methacrylate or α-methyl styrene), we expect the steric hindrance of the polymer of structure (*a*) to be of the same order as for poly*iso*butene, where X_1 is CH_3. The fact that the steric hindrance caused by the large groups $COOCH_3$ and C_6H_5 is of the same order as that of CH_3, is because the carbon atoms which join them to the polymer backbone have coplanar and not tetrahedral valencies. This enables the adjacent groups to lie in planes parallel to each other, so that although they are large their mutual interference is of the same order as for CH_3. We have measured the heats of polymerization of methyl methacrylate and acrylic acid and find values of 11·6 kcal. per mole and 18·3 kcal. per mole respectively*. It seems reasonable to attribute the difference to the presence of steric hindrance in the case of the 1.1 disubstituted ethylene, and its absence in the monosubstituted ethylene. This involves the assumption that the polymer of methyl methacrylate is at least predominantly of the head-to-tail type. The theoretical values for the sterically unstrained polymer cannot be calculated in this case.

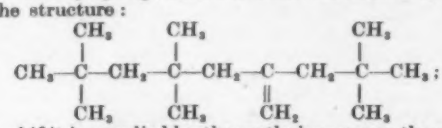
The smallest molecule in which we would expect steric hindrance to be marked is the nonane $C(CH_3)_3 . CH_2 . C(CH_3)_3$. This molecule has the same structure as a section of the head-to-tail poly*iso*butene molecule. In the nonane $C(CH_3)_3 . C(CH_3)_2 . CH_2 . CH_3$, which is of a head-to-head type, little steric hindrance should be observed. Experimentally, we found signs of steric hindrance reducing the heats of formation in the dimerization of C_9H_{18} to $C_{18}H_{36}$ by boron fluoride. For the heat of this dimerization we find the upper limit of 14 kcal., whereas the value calculated in the absence of steric hindrance would be 20 kcal.

The dimer $C_{18}H_{36}$ was identified as an olefine. This excludes its formation through the intermediate stage of free radicals, since in this case the only possible dimer would be a saturated compound containing a four-membered ring. The mechanism of dimerization, therefore, must consist in the migration of a hydrogen atom from one monomer molecule to the other. If any methyl group would serve equally well for the production of the migrating hydrogen atom, one would expect that the action of boron fluoride on di-*iso*butene would produce some poly*iso*butene thus:

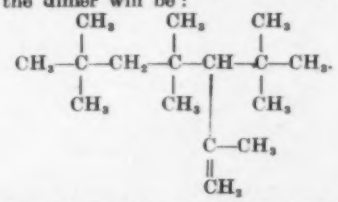


The fact that this does not occur indicates that the terminal methyl groups farthest from the double bond are not active as regards the liberation of hydrogen atoms. The absence of reactivity in these groups is in accordance with the observed behaviour of the methyl groups of a saturated hydrocarbon, as shown by the fact that when a solution of *iso*butene in hexane is treated with boron trifluoride there is no reaction between the *iso*butene and the hexane. It follows that the only active groups in the di-*iso*butene molecule are the methyl and methylene groups attached directly to the double-bond carbon. These groups are active by virtue of the resonance which can occur in the radical $R{-}\dot{C}(CH_3){=}CH_2$ or the ion $R{-}C(C\bar{H}_2){=}CH_2$ which is formed by the loss of a hydrogen atom or a proton.

If the migrating hydrogen atom is supplied by the methyl group, then the dimer molecule will have the structure:



and if it is supplied by the methylene group the structure of the dimer will be:



Both these compounds are olefines, which show the presence of strong steric hindrance. Further growth by this mechanism would be increasingly difficult sterically and would be accompanied by still further reduced, probably prohibitively small, heats of formation. These are the characteristic features observed in the action of boron fluoride on di-*iso*butene.

If we consider that the polymerization of *iso*butene occurs by the same mechanism as that which we have deduced for di-*iso*butene, we find that the structure of poly*iso*butene must be of the head-to-tail type, in accordance with the evidence quoted earlier on.

* We note that Goldfinger, Josefowitz and Mark (*J. Amer. Chem. Soc.*, **65**, 1432; 1943) found the value 7·9 kcal. per mole for the heat of polymerization of methyl methacrylate. While we are not in a position to argue the point until the detailed publications can be examined, we believe our value to be correct. In any event, the difference would not affect the argument of this article.

The above considerations would still apply on the assumption that the migrating hydrogen atom came from the $=CH_2$ group, but the eventuality does not seem worth discussion, since such hydrogen atoms are known to be unreactive, as exemplified for the present case by the absence of reaction when ethylene is acted on by boron fluoride.

Our thanks are due to Imperial Chemical Industries, Ltd. (Billingham), for directing our attention to the problem and supplying us with information and material. We also wish to thank Prof. M. G. Evans for important advice on the method of polymerizing methyl methacrylate and acrylic acid, and Mr. J. H. Allen for experimental help.

A detailed account of these experiments will be published after the War.

[1] Thomas, Sparks, Frolich, Otto, Mueller-Cunradi, *J. Amer. Chem. Soc.*, **62**, 276 (1940).
[2] Fuller, Frosch and Pape, *J. Amer. Chem. Soc.*, **62**, 1905 (1940).
[3] Flory, *J. Amer. Chem. Soc.*, **65**, 372 (1943).
[4] Pauling, "The Nature of the Chemical Bond" (Cornell University Press, 1940).
[5] Flory, *J. Amer. Chem. Soc.*, **59**, 241 (1937).
[6] Rossini and Knowlton, *J. Research. Nat. Bur. Standards*, **19**, 339 (1937). Prosen and Rossini, *ibid.*, **27**, 289, 519 (1941).
[7] Richardson and Parks, *J. Amer. Chem. Soc.*, **61**, 3545 (1939).
[8] Rossini, *J. Research. Nat. Bur. Standards*, **15**, 361 (1935).
[9] Kistiakowsky, Ruhoff, Smith and Vaughan, *J. Amer. Chem. Soc.*, **57**, 881 (1935).
[10] Jessup, *J. Research Nat. Bur. Standards*, **20**, 589 (1938).

THE REGIONAL CONCEPT IN GEOGRAPHY

By W. FITZGERALD
University of Manchester

BEFORE the autonomous development of the natural sciences occurred, geography embraced almost all investigations of terrestrial phenomena. This was largely true until the Renaissance and the important voyages of discovery greatly enlarged man's knowledge of the earth's surface. As the sciences took shape in turn it became necessary for geography, in order to retain its identity, to develop its own method, discipline and philosophy and to define the limits of less comprehensive but more specialized investigations. It became, moreover, equally important to state or re-state the relationship of geography to those sciences with which its contacts are closest.

Geographers were slow to adjust their philosophical frontiers to the expansion of science. In the late nineteenth century they had particular difficulty in defining the position of their subject in relation to geology and ethnology, which were reaching full maturity. More recently, meteorology has claimed independent status, and its relation to geography still awaits satisfactory adjustment. The sciences named are those with which geography retains the closest contacts, and between them and geography the boundaries are not always easy to determine.

During the last half-century geographical studies in Britain have undergone a transformation similar to that which occurred in France and Germany at an earlier time. The philosophical evolution of geography has not, however, greatly affected those who would limit the subject to the physical phenomena of the earth's surface and exclude man's adjustment to environment from their terms of reference. The study of land-forms (geomorphology), the atmosphere and the oceans, which comprised the physiography of the late nineteenth century, is the interest of those who claim that scientific geography can go no farther. But much of the geomorphology which passes for physical geography is concerned with the evolution of land-forms. As such it is geology. This was made clear so long ago as 1887 by Prof. J. Geikie when he wrote, "The moment the physical geographer begins to inquire into the origin of any particular physical feature he enters upon the domains of the geologist"[1]. The great geomorphologists—Lord Avebury, Archibald Geikie, Grenville Cole, and others of a recent generation—were geologists primarily, though their secondary interests enabled them to make distinguished contributions to physical geography.

The physical geographer is not required to approach the study of land-forms from the same point of view as the geologist. He is principally concerned with the actual geographical location of terrestrial phenomena and with their spatial relationships within the regional framework of the world; so that his statements must be capable of being expressed cartographically. In physical geography, as in all aspects of geography, if the problem cannot be studied by means of maps, particularly by a comparison of maps of related distributions, it is questionable if the work is legitimate. It is more usual than not for geomorphologists to exclude man from those agencies which determine landscape. Yet to the geographer the changes wrought by man's occupation of the earth are undeniably important. The deforestation of continental areas, the drainage of marshes and shallow seas, the canalization of rivers, the tunnelling of mountain-systems are all features of the physical environment which are as 'natural' as those wrought by geological or climatic agencies—that is, if we accept man as a part of Nature.

A line of argument similar to that used in defining the relations of geology and geography may be followed in tracing the relation of physical geography, on its climatic side, to meteorology. The physics of the atmosphere is not a branch of geography, and a meteorologist undertakes his researches without necessarily possessing a geographical outlook. The climatic geographer is particularly interested in the zonal or regional arrangement and distribution of climates; whereas the geographer (without prefix), in addition to this, undertakes the investigation of the relation of climate—as one aspect of physical environment—to the life of mankind, the setting of the inquiry being, as always in geography, an areal unit or region.

To the geographer the pattern in which phenomena are arranged within an area is a matter of primary importance. He is concerned not only with their spatial relationships, but also with their interactions, as, for example, the effect of climate on the characteristics of vegetation. The geographical pattern changes, usually by a graded transition rather than abruptly, from one area to another, and grants a distinctive character—a 'personality'—to the unit of area called the 'region'. As the region is a concept, its frontiers are fixed not by Nature but by the geographer, and there may not always be agreement among geographers regarding either the regional boundaries or the criteria on which the delimitation of the region is based. Regions provide a framework which is convenient and, indeed, necessary for the systematic investigation of the environment of man. Without such a regional plan of the world as an instrument, systematic geographical investigation is not possible. There is, unfortunately, the necessity to employ the term 'region' for every unit of area

irrespective of its magnitude, as the English language is deficient in words which signify regions of different dimensions. Attempts to coin regional terms, comparable to 'pays' of the French, have, unfortunately, failed to obtain general recognition from the main body of geographers.

The division of the world into political units is scientifically unsatisfactory to the geographer, because the criteria on which it is based bear no necessary relation to geographical reality; and largely because of the inadequacy of States as geographical units the idea of the 'natural region' has been introduced. Its theory is to group together geographically the factors of environment within a scientifically acceptable framework in order the better to investigate their spatial relationships. A comparison of the historian's and the geographer's methods may help to clarify the purpose of regional division. The historian, confronted with the investigation of all history, prepares a chronological system of periods, according to criteria the relative importance of which he alone is able to determine. Only by such a division of time is he enabled to undertake the detailed investigations which are essential to the standards of historical scholarship.

The theory of natural regions was introduced to geographical thought in Great Britain by Herbertson of Oxford at the beginning of this century. The validity of the system which he devised is still widely acknowledged, though there have been alternative systems, notably those of Continental geographers. To Herbertson climate was the factor of environment which exerted the greatest influence on man; and for him it was the principal criterion of regional division. There is a considerable measure of agreement regarding the indirect influence of climate on civilization through the medium of its control of earth-sculpture, soil characteristics and vegetation, though there is objection to a theory of the climatic control of human life. Other, but subsidiary, criteria introduced by Herbertson to his regional division of the world included both orography and situation with reference to land and sea, but in the last analysis his regions are of climate. As such they comprise merely one category of natural region with which may be compared regions of vegetation and geomorphological regions, which are equally 'natural'.

All such systems agree in their limitation of the term 'natural' to phenomena which are external to man and unaffected by his activities. In recent time, however, certain geographers have claimed for man, as the architect of the cultural landscape, a place in a system of natural regions. To them the cultivated soil, for example, is a phenomenon as 'natural' as the primeval forest. The introduction of man as an agent of geography greatly complicates the attempt to reach an agreed basis of regional division. Nevertheless, it demands attention, more particularly because of its service in bringing together in fruitful relationship the physical geographer and the geographer of humanistic interests.

The wide divergence of interests between geographers in Great Britain would probably not have arisen if the subject had been consolidated at the time when geology and ethnology were completing their separation from it. For such a task a man of scientific and philosophical equipment equal to Alexander von Humboldt or Carl Ritter was required; and it is regrettable that there was no such British geographer in the nineteenth century to prepare the foundations. The backwardness of geographical investigations in Britain during that century, in contrast to the great activity in France and Germany, demands an explanation, but for our present purpose it is sufficient to indicate that geography in Britain suffered from both lack of discipline and uncertainty of objective in the early stages of its active growth.

When physical geography is re-orientated, with the regional concept at its centre, as already proposed, a considerable advance will have been made towards the elimination of the dualism which now permits the physical geographer and the geographer of humanistic interests to follow divergent courses. The unification of the subject would be assisted by the abandonment of the term 'human geography' which has only recently come into currency. It is widely misunderstood, as well it might be, for it is a mistranslation of 'la géographie humaine' which cannot be so literally rendered in English. The aspects of geography which it comprises are social, economic and political, and as prefixes to 'geography' these adjectives are sufficient. (The legitimacy of 'racial geography' is more doubtful, and will be mentioned later.)

The unification of geography depends, however, on more than the elimination of an unsatisfactory yet widely used term. It proceeds from the recognition by the geographer of humanistic interests—whether social, economic or political—that, like the physical geographer, he is concerned with the spatial relationships of certain phenomena which are involved in the life of man within a region, or series of regions. He investigates the geographical record of man's activities in economic, social and political affairs, but his unit of study, it cannot be too strongly insisted, is the place or region.

The place of man in geography offers the greatest of all practical difficulties in the systematization of the unified subject. Man is studied from different points of view in a number of other sciences, including physical and social anthropology, with which ethnology is so closely akin as to be almost synonymous, and archæology. To the geographer man is interesting because (1) in his settlement and other activities he responds to the opportunities which his environment offers, and (2) in his response to the conditions of environment he alters the characteristics and the spatial arrangement of the phenomena which constitute the environment.

The distribution of the human population over the world is undoubtedly of legitimate interest to the geographer. How that distribution has come about, the effect it has on the pattern of phenomena within a region, and the influences which are at work to alter the distribution—these are topics which the geographer studies without challenge. In regard to the somatic characters of man, only the anthropologist speaks with authority. There are undoubted racial differences between the populations of different zones, but the description of those differences in their relation, if any, to environment might well be left to the anthropologist or ethnologist, until the causes of racial differentiation between one community and another have been much more thoroughly investigated.

The argument of this article is, in effect, a recommendation of the regional method in the study of geography. It is, indeed, more, for it suggests that there is no alternative method of approach. The geographer's unit is the region, and only by reference to it does he make his distinctive contribution.

[1] *Scot. Geog. Mag.*, **3**, 401 (1887).

TAXONOMY OF THE MOTHS INFESTING STORED FOOD PRODUCTS

By DR. A. STEVEN CORBET
British Museum (Natural History)

UNTIL about a quarter of a century ago, the identification of butterflies and moths was effected, almost entirely, by comparing their wing- and body-colour patterns with named material in collections or with published figures and descriptions. Inevitably, differences of opinion arose, which could not be resolved on morphological evidence, between collectors who knew the insects alive and systematists who studied them dead. The prolonged controversy about the conspecificity or otherwise of the Pierid butterflies *Catopsilia crocale* (Cramer) and *C. pomona* (Fabricius) in the Oriental region is a case in point[1].

Although it is more than a century ago since Rambur[2] showed that the male genital organs were a satisfactory criterion for separating the superficially very similar species of butterflies in the group allied to the British 'grizzled skipper', *Pyrgus malvæ* (Linnæus), it is only within the last forty years or so that other investigators, such as Rothschild and Jordan, Chapman, and Pierce, began to investigate the genitalia of certain lepidopterous groups in which they were interested. The male genitalia—or, more precisely, the male external genitalia—consist of an assemblage of paired and median structures, usually heavily chitinized, that come into operation during the act of copulation. It became evident that, while not entirely immune from variation, the characteristics of these organs were much less subject to modification than were those of the colour pattern and other characters previously used for specific discrimination. In the majority of cases the specific features of the male genitalia were found to remain practically constant throughout whole series of insular geographical races, even among species where the wing patterns of some of the constituent races were quite dissimilar.

In practice, most attention has been paid to the characteristics of the genitalia of the male, which are more complex than those of the female, and so have greater potentialities for displaying differences in shape and size of the constituent parts. The simpler female external genitalia appear to show fewer specific differences and, in point of fact, seldom show any among closely related species when the genitalia of the corresponding males are devoid of specific distinctions.

The use of the genitalia to prove the conspecificity of geographical races showing markedly different superficial characters has been mentioned above. The converse situation occurs in which the uniformity of superficial characters of colour pattern, etc., point to the conspecificity of specimens from a wide geographical range, while the genital characters separate them into a series of distinct groups corresponding to different geographical localities. Thus, in a remarkable case known to me[3], the Lycænid butterfly *Pratapa anysis* (Hewitson) shows no marked differences in its superficial characters throughout its range from Nepal, through Burma and Malaysia, to the Celebes, but, on the basis of the male genitalia, the specimens fall into clearly differentiated groups which correspond exactly with the geographical subregious found in the range of the species. It may be added that these differences are of a degree found elsewhere in the genus only between distinct species.

The examination of the genitalia is not a universal panacea for problems in the taxonomy of the Lepidoptera. There are cases, particularly among the Pierid and Danaid butterflies, where related but undoubtedly distinct species have the genitalia structurally indistinguishable. However, even after allowance has been made for these exceptions, the fact remains that the genitalia afford the most reliable means of specific discrimination for the vast majority of the Lepidoptera.

With the moths, progress has lagged far behind that with the butterflies. A notable contribution has been the work of Pierce[4] and his collaborators, who have figured the male and female genitalia of all the British species of Lepidoptera with the exception of the minute leaf-mining Nepticulidæ. The European species of this latter family have been similarly investigated by Petersen[5]. Only in the family Sphingidæ ('hawk moths') have the male genitalia of the species of the whole world been comprehensively studied and figured (Rothschild and Jordan[6]).

Almost always, the examination of a group on the basis of the genital structures results in an increase in the number of recognized species, many former species being revealed as 'species-complexes' consisting of an assemblage of species distinct in respect of their genitalic characteristics, but possessing the same general facies as regards colour pattern, etc. There are a few instances where examination of the genitalia has led to a reduction in the number of species recognized; thus, in the Danaid genus Euploea Fabricius of the Indo-Australian and African regions, the number of listed species has been cut to a third of its former dimensions.

This systematic technique—the examination of the characteristics of the external genitalia—is not a tool reserved for those interested in the speciation and distribution of the larger and more conspicuous Lepidoptera. It is available for application to the smaller species of moths which directly affect the affairs of mankind and hence are of immediate concern to the economic entomologist. Without accurate knowledge as to the specific status of the material which is the subject of experimental work, research in quest of methods of eliminating or controlling these noxious moths will rest on a flimsy foundation. While results obtained by an empirical or semi-empirical process may lead to successful methods of control in some cases, it is only possible to bring research to full fruition and to marshal all the potentialities of the discoveries made if the data used for the identification of the species is based on careful systematic work employing an up-to-date technique.

The War has served to throw emphasis on moths the larvæ of which infest stored food products, and it became apparent that our knowledge of the systematics of these insects was very far from complete. A reinvestigation of the taxonomy of the species of moths involved was initiated, therefore, by the Department of Entomology at the British Museum (Natural History) and was carried out by me, in collaboration with W. H. T. Tams. The full results of this investigation are in course of publication[7], although the main discoveries made in respect of the commoner moths have been incorporated in a pamphlet in the Economic Series issued by the Museum[8].

Of these moths of economic importance, only the

Pyralid genera Ephestia Guenée and Plodia Guenée had been worked out satisfactorily[8], but, even in this group, it has recently transpired that one of the commoner species is, in fact, a species-complex. In other groups, the work carried out at the British Museum has shown that, as was expected, yet other species-complexes are present. This is the position with such well-known insects as the 'large tabby moth', *Aglossa pinguinalis* (Linnæus); the 'honey moth', *Achroia grisella* Fabricius; the 'corn moth', *Tinæa granella* (Linnæus); and the 'white-tip clothes moth', *Trichophaga tapetzella* (Linnæus), and it is highly probable that, were more adequate material available for study, the position of other species would be found to be similarly complicated. In some of these species-complexes, the two or more closely related species fly together, whereas in others it would seem that the overlap in the distribution is of a comparatively recent date; the latter may constitute examples of geographical races becoming established as separate species. In the British Museum there is a paucity of material from America; but the impression has been gained that the apparently similar New World forms are by no means always so closely related to the Old World species as is generally supposed.

Often the differences in the genitalia between these closely allied species are small although constant, but, judging by the position in groups of which a sufficiency of specimens is available, it is usually possible to correlate some distinctive features in the wing pattern with these differences in the genitalia. With certain species, at present, an examination of the male genitalia is the only certain means of identification, particularly with rubbed specimens which often constitute the material available.

The important question arises as to whether the species of moths in these species-complexes, which differ constantly almost only in the genitalia, exhibit differences among themselves in the earlier stages, and in the larval food and habits. As yet, we have little exact information on this subject; but it may be remarked that, of the four closely allied species in the *Tinæa granella* complex, although *T. granella* (L.), *T. infimella* Herrich-Schäffer and *T. cloacella* Haworth are so similar in wing pattern that identification of a single specimen may be impossible without recourse to examination of the genitalia, only the larvæ of *T. granella* and *T. infimella* have been found infesting grain, although all three species, together with the quite similar *T. ruricolella* Stainton, are known to utilize certain species of fungi as the larval food material. Moreover, it appears that *T. granella* prefers wheat, while *T. infimella* favours rye: although this latter species is a pest of stored wheat in Scandinavia, it has not yet been found infesting grain in Britain. A dissimilarity in larval behaviour is found in the two rather similar species of *Ephestia*, *E. sericarium* Scott (= *kühniella* Zeller), well known as the 'Mediterranean flour moth' or 'mill moth', and *E. elutella* (Hübner), the 'cacao moth'. The mill moth is a notorious pest in flour mills throughout the world, the larva feeding on flour at all stages in the milling process and constructing webbing which eventually impedes the operation of the machinery to such an extent that fumigation of the mill is necessary. On the other hand, the larva of *E. elutella* attacks the whole wheat grain, but shows a partiality for the germ: this species is also a well-known pest of other food products such as dried fruit, cacao beans, etc.

Much work remains to be carried out in this field of economic entomology, but it is clearly essential that the taxonomic studies should first be completed. It is a waste of time to attempt to investigate the life-histories and habits of living material consisting of a complex of unresolved species. Although the work at the British Museum has placed the systematics of the food products moths on a reasonably firm foundation, there are still a few threads to be unravelled, and, doubtless, quite a host of names remains to be added to the lists of synonyms.

It may be added as a matter of interest that recent work on the chætotaxy of the lepidopterous larvæ infesting stored food products carried out at the British Museum by Dr. H. E. Hinton[10] has shown that, with a number of species, identification of the larvæ is easier and more certain than is the case with the adult moths.

[1] Wheeler, L. Richmond, *Entomologist*, **76**, 89 (1943).
[2] Rambur, P., "Faune entomologique de l'Andalousie," **2**, 312 (1840–42).
[3] Corbet, A. S., *Proc. Roy. Ent. Soc. Lond.*, (B) **7**, 166 (1938).
[4] Pierce, F. N., "The Genitalia of the Group Noctuidæ of the Lepidoptera of the British Islands" (Liverpool, 1909), followed by similar monographs on the other major groups.
[5] Petersen, W., *Stett. ent. Z.*, **91**, 1 (1930).
[6] Rothschild, Lord, and Jordan, K., *Nov. Zool.*, **9** (supplement), 1–972 (1903).
[7] Corbet, A. S. and Tams, W. H. T., *Proc. Zool. Soc. Lond.* (B), **113**, 55 (1943).
[8] Hinton, H. E., and Corbet, A. S., "Common Insect Pests of Stored Food Products", British Museum (Natural History), Economic Series, No. 15 (1943).
[9] Richards, O. W., and Thomson, W. S., *Trans. Ent. Soc. Lond.*, **80**, 169 (1932).
[10] Hinton, H. E., *Bull. Ent. Res.*, **34**. No. 3 (in the press) (1943).

OBITUARIES

Prof. Isidor Traube

THE death of Isidor Traube at Edinburgh at the age of eighty-three brought to a close a life of great significance to present-day exponents of physical and colloid chemistry. Born at Hildesheim of Jewish parents (his father was a merchant), Traube entered the University of Berlin in 1879, where he studied chemistry under A. W. Hofmann and physics under Helmholtz. Later he worked in the physiological institute of Du Bois Reymond, and was awarded his doctorate for a thesis in the field of organic chemistry. After a period of military service, which appears to have been little to his liking, he became for a period assistant to Bernthsen. Contact with Bunsen and Hermann Kopp turned his thoughts to the then embryonic science of physical chemistry and in particular to the phenomena of solution, adhesion and cohesion, to the study of which so much of his life was later to be devoted.

Greatly impressed by the experimental results of Raoult, Traube's speculative mind early recognized the relation between the gas laws and Raoult's empirical laws relating to dilute solutions; he was aware also of the implications regarding the dissociation of the electrolytes to which many of Raoult's data referred. Unfortunately for Traube, instead of publishing his interpretations of these results (his paper would have anticipated van't Hoff by two years), he communicated them (1884) to Lothar Meyer, then professor of chemistry at Tübingen. Meyer, unimpressed by the accuracy of the Frenchman's data, which in his opinion required further substantiation, cautioned the young Traube against hasty publication. The papers of van't Hoff and Arrhenius were published in 1886–87.

After a short interval in Heidelberg, Traube migrated to Bonn, where he worked as assistant at the Agricultural Academy. It was there that he began his studies of the viscosities and surface tensions of liquids. So early as 1891 he expressed the opinion that the molecules forming adsorbed films at the surfaces of solutions obey equations of state analogous to those of three-dimensional gases, the area per molecule being the analogue of the molecular volume, and the lowering of surface tension that of the gaseous pressure. This time Traube anticipated the march of scientific opinion not by two but more nearly by thirty years, for it was not until the impetus given to the study of surface phenomena by Hardy, Langmuir and Harkins had made itself felt that the correctness of his view was firmly established by Adam (1921), Volmer (1925) and others.

Already in 1885 Traube had shown that with members of a homologous series dissolved in water (for example, the lower alcohols or the alkyl acetates) equal lowerings of the surface tension of the water were produced by concentrations which decreased *geometrically* about three-fold for each additional CH_2. In much later work he extended a form of this generalization (Traube's rule) to adsorption at liquid/liquid and solid/gas interfaces, although he was careful in this last case not to confuse the affinity or free energy of adsorption, to which the rule would apply, with the saturation capacities of the surface, to which it would not.

Traube found a practical outlet for these discoveries in the assessment of the fusel oil contents of spiritous liquors. He also applied his theories of film formation and surface activity to explain the viability of drugs in living tissues (1904). Ever since its formulation, Traube's theory of drug action has exercised a profound influence on pharmacological research, and perhaps to-day more than holds its own against the rival lipoid solubility hypothesis of Overton and Meyer. Traube's other studies included such diverse subjects as the molecular volumes and intrinsic pressures of pure liquids (1895–1920), the theory of critical phenomena (1902), colloidal gold, the theory of catalysis (1913), the stability of matter in the submicronic state of division (1928–29) and the froth flotation of minerals and of organic chemicals.

A careful experimenter and possessing an exceptionally penetrating mind, Traube was never over-elaborate either in his laboratory techniques or in his formulation of theories. Unlike those of his great contemporaries, Nernst and Ostwald, his writings were never pontifical, and, so far from their becoming current dogma, it was left to later generations of chemists to appreciate their essential merit.

After holding for a third of a century the title of 'extraordinary' professor at the Technische Hochschule, Berlin, Traube came as an *émigré* to Britain in 1934. He settled in Edinburgh, where he was welcomed as a guest of the University. Active-minded to the last, he completed shortly before he died the manuscript of a book of reminiscences. To this and to his surviving daughter, Dr. S. Boas-Traube, I am indebted for the biographical details given in this note.

D. H. BANGHAM.

WE regret to announce the following deaths :

Mr. J. S. Addison, deputy chairman of Courtaulds, Ltd., and chairman of the scientific advisory committee of the Empire Cotton Growing Association, on December 15.

Mr. Edward A. Martin, formerly secretary of the South-Eastern Union of Scientific Societies, on December 14.

Mr. H. F. Witherby, M.B.E., the well-known ornithologist and publisher of works on natural history, on December 11, aged seventy-three.

NEWS and VIEWS

A Programme for Reconstruction

THE statement, "Forward—By the Right", issued by the Tory Reform Committee (Pp. 16. Tory Reform Committee, House of Commons, London, S.W.1), is of considerable interest to scientific workers as indicating principles and objectives on which there is a large measure of general agreement, however widely opinions may differ as to the measures by which the objectives are to be attained. Eight principles are enunciated and illustrated : national unity ; empire unity ; the interdependence of nations ; the full development of resources ; the practical approach ; individual freedom ; trusting the people ; and finally, that of first things first. Much general support will be found for the view that in Imperial affairs attention should be transferred from abstract questions of political status to such practical problems as Imperial defence, air and sea transport, broadcasting and communications, education, research, economic development and migration. In regard to the interdependence of nations, it is urged first that those military organizations for consultation and joint action which exist between the United Nations should be maintained, and also those organizations such as the Middle East Supply Centre which could be adapted to the needs of peace and assist in removing the causes of dispute. The International Labour Office and the Hague Court should be revived and such joint enterprises as are exemplified in the Hot Springs Conference developed. While mutual co-operation and understanding between the British Commonwealth, the U.S.A., the U.S.S.R. and China must form the basis for establishing a framework of stability, the final framework of any world organization will require a broad foundation.

Under the development of resources, the Statement, after emphasizing the necessity of a policy of full employment, including Empire development, agriculture and the development of exports, calls for the devotion of far greater resources in men and money to scientific and technical research, including provision in the educational system of Great Britain for the increased numbers of trained scientific workers required. On the question of planning, the Statement is not clear, but it emphasizes the necessity both of ample statistical and other information as a basis, as well as ensuring that the objectives of policy command general support. Dealing with public control, it is advocated that the public interest should be the decisive test ; private profit is not accepted as the sole test of public advantage. The peace-time essentials are regarded as, first, the retention

of adequate armaments and compulsory military training; secondly, full employment as a condition of individual self-respect and independence, and as a guarantee that the maximum effort is being harnessed to the national objectives; thirdly, the provision of homes for all of an adequate standard; fourthly, the establishment of an educational system which will enable any child to develop his capacities and character to the full; and fifthly, social security guaranteed by adequate minimum wages and a system of social insurance on the lines proposed by Sir William Beveridge.

Transport Problems in Reconstruction

SUPPLEMENTING two earlier broadsheets, Nos. 202 and 207, on "Retail Distribution and Town Planning" and on "Space for Leisure", respectively, Political and Economic Planning has now issued a further broadsheet in its attempt to analyse the needs of the consumer which physical planning should satisfy. This broadsheet, "Use and Misuse of Transport" (No. 211), reviewing first the general problems of pre-war transport in Great Britain, including the mounting delays, excessive journeys, travelling to work and the consequent loss of time, points out that if the full social costs are taken into consideration, the value of a great proportion of the transport which has been considered as normal is not commensurate with the price paid for it in money, time, energy, ill-health and loss of amenity. The position could not have been allowed to drift for many years longer without a real crisis developing. Dealing first with the comparatively limited question of reducing pressure on the roads, the broadsheet emphasizes that if travel by public vehicles in place of private car or vehicles is to be encouraged, accessibility is the key to the whole problem. More parking space and legal recognition of joint ownership of a car, the development of retail delivery services, and the utilization of any possibilities of underground travel as well as travel by air, are suggested; and the broadsheet gives a warning against allowing ourselves to be left behind in utilizing the air, as we were by the rapid development of the internal combustion engine.

The major possibilities, however, lie in the reduction of the demand for transport. The wider utilization of piped services and of the telephone in eliminating journeys is obvious, but the decentralization of services and amenities so as to rectify serious mistakes originally made in housing estates is also important. The major problem is that of reducing the journey to work, but there are limits to the alleviation which local employment can provide in this respect, and the broadsheet analyses closely the possibilities which zoning offers, particularly in regard to segregating traffic. Six different types of zone are enumerated, and discussing their interrelation, the broadsheet suggests that industry, warehouses and wholesale markets should be placed on the outskirts of a town; living quarters, offices, shops and schools would then be kept free from the intrusion of heavy traffic. Recent plans for large towns have shown a tendency in this direction. Such zoning, however, leads to the question whether synthesis is possible between the principles of the neighbourhood unit in which people's lives are localized, and of zoning, which is recommended for reasons of economic efficiency, of amenity and of a rational arrangement of transport. The problem of securing employment for people near their homes is more intricate than the decentralization of services and leisure facilities. While it is important that the light mobile industries should account for a much higher proportion of total employment, the issues cannot be decided purely from the point of view of transport, and a broad approach to this very broad problem is essential, as well as vision and boldness.

Association of Scientific Workers of Southern Africa

THE success achieved by the Association of Scientific Workers in Britain, the United States, and Australia, has inspired the establishment of a similar Association recently in South Africa, under the title of the Association of Scientific Workers of Southern Africa. Various problems such as the recent and still incomplete industrialization of the country, the widely scattered population, and the great distances between the few considerable urban and industrial centres, have necessitated an approach to problems of organization and policy differing a good deal from those adopted in Britain to achieve the same fundamental aims of promoting the application of science and the scientific method to the welfare of mankind, while at the same time furthering the professional interests of scientific workers. Also, the statutory position of a trade union is quite different in South Africa from that in Britain.

The establishment of the Association in South Africa met with a good response. The two branches, Johannesburg and Cape Town, now have a joint membership from all parts of the Union and the Rhodesias of more than 350. Public conferences have been arranged and have attracted considerable attention. Memoranda have been presented to the Government Health Services Commission, and the Social and Economic Planning Council, and for publication, on various problems concerning the application of science to national problems. Recently the Association co-operated with the Medical Council in the matter of registration of laboratory technologists, who now form a large and enthusiastic group within the Association. The Association is also at work through special sub-committees, on war emergency problems, education, research, finance and organization, and similar problems. It is expected that further branches will be established in the near future. The chairmen and addresses of the two existing branches are P. S. Malan, P.O. Box 1065, Cape Town, and Rena G. Knight, P.O. Box 8083, Johannesburg.

Scientific Film Association

THE Scientific Film Association was formally constituted at an extraordinary general meeting held on November 20. The primary aim of the new Association is to promote the national and international use of the scientific film in order to achieve the widest possible understanding and appreciation of scientific method and outlook, especially in relation to social progress. It will also collect, collate and distribute information on the scientific film, and publish comprehensive lists of films graded according to scientific merit and suitability for audiences. The Association hopes to establish relations with Government departments, public bodies and other organizations which are in a position to make, use or circulate scientific films; and it is also proposed to organize a representative panel of men of science to advise producers of films of all types on scientific matters in connexion with such films and to maintain close contact with

the film industry. All inquiries should be made to M. Michaelis (honorary secretary), 51 Fitzjohn's Avenue, London, N.W.3.

Prehistory in the Deccan

So long ago as 1930, in the September number of *Antiquity*, Mr. M. C. Burkitt made an attempt to set out in some order the early archæological discoveries of south-east India. The bases for the study were the finds and notes made during a long period of years by Mr. L. A. Cammiade over a wide area of country including the districts along the lower reaches of the Godavari River. Actually, the finds made near this river were all from the surface and could not be accurately dated. They were, however, mostly microlithic in character; but it was clear that many ages were represented. Mr. H. D. Sankalia has now published a short article, "Studies in Prehistory of the Deccan (Maharashtra): a Survey of the Godavari and the Kadva near Niphad" (*Bull. Deccan Coll. Res. Inst.*, **4**, No. 3) which, while not taking us much further, has a certain interest. Briefly, the Godavari has, in places, cut down through the trap to a low level, having previously deposited on the trap a series of gravels in which Mr. Sankalia has discovered a few artefacts *in situ*. Unfortunately, the illustrations are not very good, and it does not appear that any outstanding finds have been made, but Mr. Sankalia is to be congratulated on having started an investigation which eventually may prove to be of considerable interest. It must always be remembered that the well-known micro-industries of the rock shelters in the Central Provinces of India, far from corresponding to the Mesolithic industries of Britain, are apparently for the most part post-Christian in date. At the same time there are post-Middle Stone Age finds of small implements in the Cammiade collection which probably do date to Late Pleistocene times. Further work by Mr. Sankalia may help to elucidate these problems.

St. John's Wort in Australia

ST. JOHN'S WORT (*Hypericum perforatum* var. *angustifolium*), introduced into Australia in about 1880 as a garden plant, is now a serious weed in many parts of that country. Besides reducing the carrying capacity of the pasture, stock may become affected with 'wort dermatitis', for the hypericin in the plant acts on the nervous system, rendering the exposed non-pigmented areas of their skin photo-sensitive. Control measures of various kinds are being tried, including improvement of the pasture by sowing competitive species, chemical treatment and the liberation of insect parasites. Some account of the success attending these trials is given in recent publications of the Australian Council for Scientific and Industrial Research. Bulletin 151 consists of a paper by R. M. Moore and A. B. Cashmore, who have investigated the problem from the agrostologist's point of view, while the entomological aspect is specially dealt with by F. Wilson and T. G. Campbell in the Council's *Journal* (**16**, p. 45). The results are most promising. Subterranean clover (*Trifolium subterraneum*), a winter-growing annual, proved an efficient competitor with St. John's wort, and in association with perennial grasses, such as *Phalaris tuberosa* or *Lolium perenne*, almost completely eradicated the weed and provided a productive and nutritious pasture. The mixture is best sown with a dressing of superphosphate after a summer fallow, a dense pasture being afterwards maintained by regular top-dressings and a rotational system of grazing. The use of dark-coloured stock is also recommended as they are less prone to wort dermatitis. For entomological control, three insects have been established in Australia, two leaf-eaters, *Chrysolina hyperici* and *C. gemellata*, and a root-boring Buprestid, *Agrilus hyperici*. The prospects of success are good, particularly with Agrilus, as it is remarkably free from predators and parasites, but the Chrysolina species have a high reproductive rate, and judging from experience in France, all three insects can play a useful part in the control of the weed.

Stellar Spectrophotometry in the U.S.S.R.

Two recent publications (*Bull. Acad. Sci. Georgian S.S.R.*, **3**, No. 6, p. 509; No. 7, p. 657; 1942) give news that astrophysics still flourishes just beyond the high-water mark of the German advance into southern Russia. At Abastumani Observatory an extensive programme of photo-electric colorimetry of *B8–B9* stars was begun in the summer of 1940 and is still in progress. The colours of all stars of these spectral types brighter than 7·5 mag., lying in a zone within 20° of the galactic equator, are being measured with an antimony-cæsium photo-cell attached to a 33 cm. reflector. Colour filters give effective wave-lengths of 4060 A. and 5280 A., the resulting colour equivalents being on a base-line slightly longer than ordinary photographically determined colour indexes. The greater sensitivity, range and stability of the antimony-cæsium cell enables the Russian observers, V. Nikonov and E. Brodskaja, to obtain observations of which the probable error is less than $\pm 0{\cdot}01$ mag. for stars brighter than the sixth magnitude, and less than $\pm 0{\cdot}02$ mag. for the fainter stars. When full results of this programme are available, they should add greatly to our knowledge of the selective absorption of light by interstellar matter situated fairly close to the sun.

Meanwhile, a vexed point regarding the colour temperature of α^2 CVen is being investigated at Mt. Kanobili. Thirty-three observations of the star taken in the spring and summer of 1941 show a maximum variation of colour temperature of 2,000°, which agrees better with the spectrum changes than the value of 10,000° found by Tai (*Mon. Not. Roy. Astro. Soc.*, **100**, 94; 1939). A puzzling feature of the observations is that the star is bluer at minimum than at maximum, a characteristic which differentiates it sharply from such intrinsic variables as Cepheids and long-period variables. Observations are being continued at Abastumani in happier circumstances than any obtaining since the inception of the programme.

South African Institute for Medical Research

THE annual report for 1942 of the South African Institute for Medical Research in Johannesburg indicates that this progressive Institute is playing its full part in the war effort. Staffed by 153 Europeans and 118 Africans, its activities are wide. In 1942, its buildings, which were no longer adequate to the large demands for serum for civilians and for army needs, were enlarged; a branch laboratory was established at Bloemfontein. The erection of a large plant for the manufacture of dried human and other serum was made possible by a grant of £10,000 from Sir Ernest Oppenheimer and the Anglo-American Corporation of South Africa. The production of

vaccines and sera for the troops has been very greatly increased; staff are being trained for the administration of military hospitals and for their laboratories, and two mobile laboratories and nineteen military hospital laboratories have been established in the Union. Special military medical problems are being investigated. Other war activities of the Institute include vitamin assays, food analyses for military needs, the production of anti-gas-gangrene serum, the study of insect vectors of disease, plague, relapsing fever, typhus and yellow fever. The list of other researches being done is impressive, and the Institute's routine diagnostic work is evidently one of its most important activities.

Rapid Disappearance of Smallpox

According to the May issue of the *Statistical Bulletin*, the organ of the Metropolitan Life Insurance Company of New York, in 1942 for the first time in the history of the United States the number of smallpox cases fell below 1,000. Eleven States were entirely free from the disease, and three other States reported only one case each. Texas alone had more than 100 cases. During the whole year there were less than ten smallpox deaths. In Canada there were only six cases and no deaths. The 897 cases of smallpox reported in the United States in 1942 showed a marked decline from the previous low record of 1,446 cases in 1941 and were only a fraction of the number for 1940, 1939 and 1938, when the cases numbered 2,797, 9,877 and 14,977 respectively. In an outbreak of 65 cases in Pennsylvania, the patients had either not been vaccinated or had long outlived their immunity. Apart from 13 unvaccinated school-children, the victims were past middle age.

Production of Rubber in Europe

A short notice of an article in *Agricultura* (128, Dec. 1942) entitled "La producción de caucho en Europa" appears in the *Revista De Formacion Y Documentacion Profesional* (No. 7; 1943). It is pointed out that in the Mediterranean basin it is possible to cultivate plants from which a secretion having the characteristics of rubber has been extracted. This question attained great importance after the occupation of the Ukraine by the enemy, because large tracts there were devoted to the cultivation of *koksagyz*, a dandelion-like plant, from which it is claimed that fairly satisfactory rubber could be obtained; the percentage of rubber from the extract was as high as 27. The article suggests that, if to this are added the species which can be cultivated in the Mediterranean basin, and also the synthetic rubber manufactured by the Germans at the Buna works, a possible solution of the natural rubber supply for European countries would be forthcoming.

Maintenance Work in Electrical Supply

A paper on "Maintenance of Distribution Plant and Mains on A.C. Networks" was read before the Institution of Electrical Engineers in London on November 10 by Messrs. F. N. Beaumont and F. A. Geary. They stated that the frequency with which apparatus should be examined, and the time to be allocated for each overhaul, are dependent on (*a*) the design of the individual unit in relation to its electrical duties and the atmospheric conditions under which it has to operate; (*b*) the electrical and mechanical strength of the materials employed; (*c*) the accessibility of the parts requiring normal inspection and testing; and (*d*) the physical lay-out and housing of the units, together with the facilities available for carrying out routine maintenance on site. The closest co-operation between the designer and the maintenance engineer is at all times desirable, in order that those details in design which require excessive maintenance may be suitably modified. It is the function of a maintenance engineer to organize the necessary maintenance, examination and testing of all sections of plant under his control, so that the plant may carry out its functional operation successfully and incipient faults be found and eradicated before they lead to failure on the line. The aspects and items of equipment dealt with in the paper are as follows. Staffing, safety precautions, record systems of plant maintenance, switchgear maintenance, batteries, transformers, transformer chambers, fire-fighting installations, protective gear and mains. The paper shows that maintenance, combined with adequate records, can foster improved design, to the mutual advantage of manufacturer and user, in order to obtain for future purposes the best design and lay-out practicable.

Electricity in Mines

A review of this subject given (*J. Inst. Elect. Eng.*, **90**, Pt. 1, No. 34; October 1943) by Mr. J. A. B. Horsley covers the use of electricity in mines under the Coal Mines Acts which are operative in Great Britain. The review gives certain statistical data and surveys technical developments, British Standard specifications, effect of recent legislation, and future developments.

Literature of Penicillin and Similar Substances

Last September the National Research Council of Canada issued "Abstracts on Penicillin and other Antibiotic Substances" (National Research Council, Ottawa: No. 1160. 1.00 dollar). Compiled by Miss Muriel E. Whalley, of the Research Plans and Publications Section, it arranges by authors 185 abstracts taken from the *American Chemical Abstracts* (1917 to Sept. 10, 1943, inclusive) and other material found in the library of the National Research Council of Canada. An index increases the usefulness of this publication and Miss Whalley is to be congratulated on her work. The abstracts deal with the chemical and biological properties of sixteen substances in all. Eight of these are obtained from bacteria, eight from fungi. Among the latter are penicillin, penatin and fumigacin, some of the properties of which have been noted in these columns recently. The properties of patulin were made known too late to be included in Miss Whalley's very useful compilation. As we go to press we learn from the ***British Medical Journal*** (Dec. 18, 1943, p. 800) that the January number of the ***British Medical Bulletin*** will be devoted to authoritative articles on, and a bibliography of, penicillin.

Rediscovery of Comet Daniel (1909 IV)

This comet was seen by Mr. G. F. Kellaway, West Coker, on Nov. 30d. 22h., and a few nights later his photographic results confirmed the position which he had adopted for it. Its magnitude at the time of discovery was 13, and it was very close to the place predicted by Mr. W. P. Henderson and Dr. H. Whichello, in the "Handbook of the British Astronomical Association", 1943.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Flow States in Emergent Gas Streams

As part of a study of factors affecting flame stability, some time ago we began an investigation into the influence of gas velocity on the flow conditions at a burner head; in the first instance unignited media were employed. The technique of instantaneous shadow photography was chosen as best for the purpose, and a preliminary series of experiments showed propane or butane as most suitable gaseous media; for, not only do the refractive indexes of these hydrocarbons differ widely from that of air, but, in addition, their immobility enhances the sharpness of the gaseous boundaries and the consequent clarity of the photographic records.

1 2 3 4

The accompanying photographs were obtained at intervals of 1/50 sec. after releasing propane abruptly from its confinement through a ¼ in. diameter tube some 40 in. in length, the velocity of the stream increasing from zero to that adequate for turbulence.

Figs. 1 and 2 indicate the primary vortex, known as 'Overbeck's vortex', conditioned by the initial expansion of propane into the surrounding atmosphere; this is followed at successive intervals by secondary vortices. Previous records of such flow, though less clearly defined, have been obtained by F. C. Johansen[1] using liquids, by G. Burniston Brown[2] using illuminated smoke streams emerging from narrow rectangular orifices, and also at the National Physical Laboratory[3], where air intermittently heated by sparks was used.

Fig. 3 indicates a transition flow state before the attainment of velocities adequate to induce turbulence (Fig. 4). Under such conditions the rising column appears to become segmented and is possibly rotating.

Our present experience indicates that while the primary vortex is a common phenomenon at all speeds below the minimum for turbulent flow, secondary vortices develop more slowly the slower the gas velocity, the distance above the orifice for a given degree of development appearing to vary somewhat inversely with velocity; also, the higher the velocity the more closely does the first secondary vortex approach the sphere of action of the primary vortex. The development of the primary vortex is also accompanied by narrowing of the main stream, due to a transfer of gas. Under the conditions described, there are doubtless velocity and pressure gradients at the front of the stream; with the attainment of steady flow, the secondary vortices are less mature on emergence but develop abruptly, at distances above the port decreasing with increasing gas velocity.

The secondary vortices are of particular interest to us as, when developed, it would appear that they are the most likely source of the periodic expansions and contractions of the outer cone of a bunsen flame, revealed either by Schlieren photography[4] or stroboscopically[5]. Also, when a non-aerated flame at an adequate feed velocity leaves a burner port but remains stationary some distance above, it appears to be sealed at the locus of rapid development of the secondary vortices.

Brown attributed the secondary vortices to the sensitivity of the stream to sound motions arising autogenously; indeed, he demonstrated their inducement by suitable sound waves from an extraneous source.

We are giving further consideration to some of the issues raised.

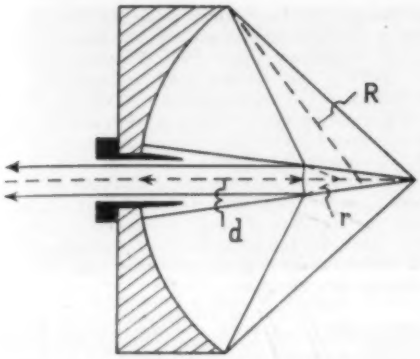
J. E. GARSIDE.
A. R. HALL.
D. T. A. TOWNEND.

Dept. of Coal Gas and Fuel Industries,
University of Leeds. Nov. 26.

[1] Johansen, F. C., *Proc. Roy. Soc.*, A, **126**, 231 (1929).
[2] Brown, G. Burniston, *Proc. Phys. Soc.*, **47**, 703 (1935).
[3] Annual Report, 1935, p. 179.
[4] Gawthrop, D. B., cf. Lewis, B., and von Elbe, G., "Combustion Flames and Explosions of Gases", p. 153.
[5] Hartley, H., *Trans. Inst. Gas Eng.*, **82**, 466 (1932-33).

Reflecting Microscopes

I HAVE read with particular interest the letter of E. M. Brumberg *et al.*[1] mentioning the use of a reflecting microscope involving two spherical mirrors, since I have myself made three reflecting objectives: one of these was shown in process of figuring (N.A. 0·58) and one completed (N.A. 0·65) at the Physical Society's Exhibition in 1939. I used non-spherical



mirror-pairs, Schwarzschild aplanats[2,3], for a reason which may prove important if it is desired to exploit fully the possibilities of reflexion microscopy—I wished to reduce the fraction of the numerical aperture obstructed by the convex mirror.

Some astronomers say that though obstructing the central third of the numerical aperture of a telescope objective does not much hinder the resolution of a double star, and may even help it if the components are about equally bright, the effect on the resolution of a very unequal double is deleterious, and the effect on the visibility of low-contrast planetary detail markedly so[4]. They suggest that the 'obstruction ratio' should not be allowed to rise above 0·2, and should preferably be lower.

The bispherical monocentric approximation to the Schwarzschild aplanatic pair has an obstruction ratio of about 0·447. To reduce this while at the same time preserving exact anastigmatism, we must choose a pair in which both mirrors are non-spherical. If we are prepared to tolerate a moderate astigmatic coefficient, we need only figure one of the mirrors, provided the numerical aperture does not exceed about 0·65. To make such an aplanat (see figure) choose the ratio of radii of curvature of the mirrors to give the desired obstruction ratio: adjust the distance between them to the tabular value for freedom from coma, and figure the concave mirror to remove spherical aberration, continually readjusting the distance between the mirrors during figuring to preserve freedom from coma: this adjustment is very critical, and must be determined empirically. Fortunately it may be used to compensate for the spherical aberration produced by a cover-glass, without introducing serious coma. The table below assumes infinite tube-length, but will form an approximate guide when the tube-length is finite.

Intrinsic obstruction ratio	0·447	0·286	0·219	0·131
Radius of concave mirror, R	3·236	6·22	8·92	16·8
Radius of convex mirror, r	1·236	1·28	1·31	1·33
Approximate distance between mirrors, d	2·00	4·45	6·72	13·3
Approx. astigmatic interfocal distance in object space, at off-axis height H	0·00	0·142 H^2	0·209 H^2	0·270 H^2
Focal length	1·00	1·00	1·00	1·00

Only actual experience with different kinds of microscopic object and different methods of illumination can decide whether there is a benefit due to reduced obstruction which is worth the labour of aspherizing one or both surfaces. It may be that these two-mirror types will be abandoned in favour of D. D. Maksutov's ingenious 'solid' reflecting objective, in which the same air-glass surface, after acting as 'first mirror' by total internal reflexion, lets out the image formed by the second (silvered) surface, at normal incidence[5]. It may be found better to use the Schmidt principle: E. H. Linfoot exhibited in 1939 two Schmidt microscopes, N.A. 0·45 and 0·54[6,7]. He has since shown that a 'through-type' Schmidt microscope using two spherical mirrors exists: the Schmidt plate lies in the object-space, and can conveniently be made by aspherizing a normal-incidence 'immersion hemisphere'[8].

I have given the general condition for anastigmatism of two-mirror systems of finite tube-length in a paper in process of publication. I hope to give a fuller account of my three instruments shortly. For the present, I have had to lay this work aside; but not before I could satisfy myself with a few test slides and an eyepiece that at any rate the visual performance of these up-to-date versions of the ancient 'compound reflecting engiscopes' is substantially the same as that of their refracting counterparts.

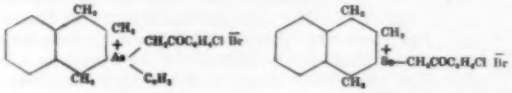
C. R. BURCH.

H. H. Wills Physics Laboratory,
University, Bristol.
Nov. 10.

[1] Brumberg, E. M., NATURE, 152, 357 (1943); *C.R. Acad. Sci. U.S.S.R.*, 25, 473 (1939); 31, 658 (1941); 32, 486 (1941).
[2] Schwarzschild, "Theorie der Spiegelteleskop" (Göttingen Observatory, 1905).
[3] Chrétien, *Revue d'Optique* (Feb. 1922)
[4] Dall, *J. Brit. Astro. Assoc.*, 48, No. 4, 163 (1938).
[5] Maksutov, U.S.S.R. Patent No. 40859, Dec. 13, 1932.
[6] Linfoot, *J. Sci. Instr.*, 15, 405 (1938).
[7] Clay, *J. Sci. Instr.*, 16, 49 (1939).
[8] Linfoot, *Mon. Not. Roy. Astro. Soc.*, 103, No. 4, 210 (1943).

An Optically Active Selenonium Salt

WE have shown that *o*-β-bromo-ethyl benzyl bromide condenses with phenyl-dichloro-arsine in the presence of sodium to give 2-phenyl-1 : 2 : 3 : 4-tetrahydro-*iso*-arsinoline[1], which readily combines with *p*-chlorophenacyl bromide to give 2-phenyl-2-*p*-chlorophenacyl - 1 : 2 : 3 : 4 - tetrahydro - *iso* - arsinolinium bromide (I). This salt contains an asymmetric arsenic atom, and we were able to resolve it into optically active forms, the corresponding *dextro* and *lævo iso*-arsinolinium picrates having $[M]_D + 457°$ and $- 450°$ respectively in chloroform solution.



This use of the bromo-ethyl benzyl bromide for the synthesis of heterocyclic systems can clearly be widely extended. We find that the bromide condenses readily with sodium selenide to give seleno-*iso*-chromane, and with sodium telluride to give telluro-*iso*-chromane. The therapeutic properties of these novel heterocyclic selenium and tellurium compounds, and of their chief derivatives, are now being investigated.

Meanwhile we have combined the selenide with *p*-chlorophenacyl bromide to give 2-*p*-chlorophenacyl-

seleno-*iso*-chromanium bromide (II). This compound contains an asymmetric selenium atom. We have therefore converted it into the *d*-bromocamphor-sulphonate, which on recrystallization from alcohol ultimately acquired a constant rotation, $[M]_D$ −271° in alcohol. This salt in turn was converted into the 2-*p*-chlorophenacyl-seleno-*iso*-chromanium picrate, which had $[M]_D$ −496° in acetone solution, and into the corresponding mercuric tri-iodide, which had $[M]_{5461}$ −535°, also in acetone solution.

The acetone solution of the picrate retained its activity unchanged when allowed to stand at 16° for 20 hours, but underwent almost complete racemization when boiled for 1½ hr. The solution of the mercuric tri-iodide underwent very slow racemization even at room temperature.

It is noteworthy that a dissymmetric arsonium halide such as (I) can racemize only by partial dissociation to a tertiary arsine and alkyl halide, that is, by the establishment of a 'dissociation-equilibrium' of the type [*abcd*As]Br ⇄ *abc*As + *d*Br. A dissymmetric selenonium halide such as (II) can, however, racemize either by the establishment of a similar equilibrium, [*abc*Se]Br ⇄ *ab*Se + *c*Br, or by direct racemization of the selenonium ion, that is, in compound (II), by direct oscillation of the *p*-chlorophenacyl radical above and below the plane of the ring. It is not unexpected, therefore, that the above selenonium picrate and mercuric tri-iodide are comparatively readily racemized.

The compound (II) is the second selenonium compound to be resolved into optically active forms: the first compound, methyl-phenyl-selenetine bromide, was resolved by Pope and Neville[2], who obtained the corresponding *dextro* and *lævo* chloroplatinates having $[M]_D$ +55° and −54° respectively.

We hope to resolve the sulphur and tellurium analogues of the compound (II), so that the rotatory dispersion of the three compounds can be compared.

F. G. MANN.
F. G. HOLLIMAN.

University Chemical Laboratory,
Cambridge.
Nov. 17.

[1] NATURE, **151**, 474 (1943).
[2] *J. Chem. Soc.*, **81**, 1552 (1902).

An Antibacterial Substance from *Aspergillus clavatus* and *Penicillium claviforme* and its Probable Identity with Patulin

B. P. WIESNER, in a communication in NATURE[1] in which he acknowledges the help and advice of Prof. H. Raistrick, Mr. George Smith and Dr. Harry Coke, reported the preparation from *Aspergillus clavatus* metabolism solutions of a concentrate possessing relatively high antibacterial activity. Similar active non-crystalline concentrates were obtained from the same fungus by S. A. Waksman *et al.*[2] and investigated recently by H. W. Anderson[3].

We have isolated the active constituent from the metabolism solution of a strain supplied to us by B. P. Wiesner as a crystalline entity, from which a number of well-characterized derivatives could be obtained. Whereas Waksman called his crude active principle 'clavacin', we had adopted the name 'clavatin'. In its pure form it has m.p. 109·5–110·5° C. and forms a mono-acetyl derivative of mp. 118–120° C. Analysis and molecular weight determinations indicate an empirical formula $C_7H_8O_4$ for clavatin.

E. Chain, H. W. Florey, and M. A. Jennings[4] reported last year the isolation of a crystalline antibacterial substance from *Penicillium claviforme*, of m.p. 110° C., for which they suggest the name 'claviformin'. We have prepared claviformin according to the above authors and established its identity with clavatin by the usual chemical methods.

In a publication by Raistrick *et al.*[5] the isolation and chemistry of patulin from *Penicillium patulum* Bainier is described. In view of the close similarity of physical, chemical and biological properties of patulin and clavatin and of their derivatives, tabulated below, it is highly probable that these two substances are identical.

	Clavatin	Patulin
Empirical formula	$C_7H_8O_4$	$C_7H_6O_4$
Melting point	109·5–110·5° C.	111° C.
Melting point of acetate	118–120° C.	118° C.
Melting point of 2 : 4-dinitro-phenyl-hydrasone	Darkens without melting	Darkens without melting
Melting point of phenyl-hydrazone	149–150° C.	152–153° C.
Melting point of oxime	152–155° C.	—
Melting point of methyl ether	69–70° C.	—
Antibacterial activity against *Staph. aureus*	1 : 64,000–128,000	1 : 64,000–128,000

The identity is further supported by our evidence from analytical experiments, collected during the past year, many of the results duplicating the findings of Raistrick *et al.* We have also isolated a reductive degradation product of clavatin identified as β-propyl-γ-butyrolactone. We have, however, obtained other experimental evidence, details of which we will publish elsewhere, which cannot yet be reconciled with the suggested structure for patulin.

Chemotherapeutic investigations have been carried out during the past year in association with Dr. F. C. Happold, Biochemical Laboratories, School of Medicine, University, Leeds. It is hoped that these results will be published in the near future.

F. BERGEL. R. KLEIN.
A. L. MORRISON. H. RINDERKNECHT.
A. R. MOSS. J. L. WARD.

Research Department,
Roche Products, Ltd.,
Welwyn Garden City.
Nov. 30.

[1] NATURE, **149**, 357 (1942).
[2] *Science*, **96**, 202 (1942) and *J. Bact.*, **45**, 233 (1943).
[3] *Science*, **98**, 282 (1943).
[4] *Brit. J. Exp. Path.*, **23**, 202 (1942).
[5] *Lancet*, II, 625 (1943).

Rate of Growth of Bracken

FOR some considerable time, the widely held belief in the slow development of bracken plants and the initiation of the frond many months in advance of its expansion has been suspect. The idea of the old German morphologists[1,2,3] of the unfolding of one frond and the growth of one internode of the frond-bearing rhizomes in a season does not fit in with the rapid rate of expansion of the plants seen in the field.

In order to test the rate of growth of individual plants, two young sporelings (each 2–3 in. across and bearing some five to six immature fronds) were put into a trough formed by slabs of concrete 3 ft. wide and 2 ft. deep, so arranged as to form a long, narrow, continuous trough some 4 in. across. This was filled with rich soil, so that the sporelings were put under optimum growth conditions. The sporelings were planted out on March 29, 1943, and left until October 11, 1943.

GROWTH OF A BRACKEN SPORELING, PLANTED MARCH 29, PHOTOGRAPHED OCTOBER 10.
The underlying soil has been partially removed to show the numerous branches of the rhizome. *A*, an immature frond, some 8 in. below soil-level.

During that time—as the accompanying photograph shows—growth was very considerable: between August and October, the number and size of the fronds increased very noticeably until they extended over the whole of the 6-ft. trough.

When the concrete slabs at the front were removed, it was found that the rhizomes were ramifying through the whole of the narrow band of soil: so much so, that the rhizome of one plant had already forced its way out between the cracks of the slabs at the base of the trough and was turning towards the damp soil in the hedge-bank alongside; while in the other case, the rhizome had extended to the extremities of the trough and two branches had forced their way through into a partition behind.

One plant was removed from the trough: this was not easy as the rhizomes were overlapping very considerably with the adjacent ones; and at three places, in order to preserve the second plant *in situ*, the rhizome had to be cut. This extracted plant showed a mass of fronds and four main rhizome leaders.

Some of the points that may be noted are:

(*a*) The plant was carrying twenty-two green fronds and a number of withered sporeling ones; also a large number of immature fronds that had not expanded. All the green fronds were of the juvenile rather than the full adult form, and none of them bore spores. On each branch of the rhizome, the largest fronds were those nearest to the distal end of the branch.

(*b*) The lengths of the longest two branches of the rhizome (measured from the central region) were: 55½ in. (141 cm.); 30 in. (76 cm.), so that these gave an overall stretch of exploratory rhizome, after one season's growth, of 85½ in. (217 cm.). These branches were running outwards and downwards from the centre, and appeared to be limited in their downward thrust only by the concrete base of the trough. (There was about 20 in. of soil in the trough.)

(*c*) The number of branch shoots, each with its rhizome branch and frond bud already laid down, was considerable. In many cases, these fronds were so deep (8–10 in.) below the surface that they could not—at the end of the season—force their way up, and had rotted. Under adverse conditions in a hard winter, others may perish similarly; but after a mild winter, since a well-formed rhizome carries large stores of food, fronds already laid down would have an advantageous start in the spring.

(*d*) The initial fronds of the young sporophyte are so small that, unless abundant in the field, they would be overlooked. Moreover, this stage would be seasonal—possibly April–June—for under congenial conditions by July they would have formed plants 1–2 ft. across, which might double themselves by October. Such clumps have been reported in heather, but until now the fact that they could be one year's growth was not recognized. Here, apparently, is one of the explanations of the rapid spread of bracken.

K. W. BRAID.

Dept. of Botany,
College of Agriculture,
Glasgow.

ELSIE CONWAY.

Dept. of Botany,
The University,
Glasgow.
Nov. 18.

[1] Hofmeister, W., "Higher Cryptogamia", 222 (Eng. Edn., Ray Soc. London, 1862).
[2] Klein, L., *Bot. Z.*, **42**, 646 (1884).
[3] Sachs, J., "Text Book of Botany", 428 (Eng. Edn., Clarendon Press, Oxford, 1882).

Stimulation of the Milk Production of Dairy Cows by Feeding Thyroid-active Iodinated Proteins

GRAHAM[1], working at the University of Toronto, and afterwards at this Institute[2], demonstrated a marked temporary galactopoietic effect of both orally administered dried thyroid gland and subcutaneously injected thyroxine in dairy cows. This has been confirmed both in Great Britain[3] and in the United States[4]. In 1914 Morse[5] found that the effects of iodinated proteins on the metamorphosis of tadpoles were comparable to those of thyroid, and more recently (1939) Ludwig and von Mutzenbecher have shown[6], and Harington and Pitt Rivers[7] have confirmed, that thyroxine can be isolated from hydrolysates of casein treated with iodine (iodinated casein). The possible use of iodinated casein for the stimulation of milk production in the dairy cow was visualized by Bottomley and Folley[8], who carried out small-scale experiments with cows[9] which indicated that transient increases in milk production could be obtained by feeding iodinated casein.

In view of these results, a detailed investigation of the effect of iodinated protein on the milk production and clinical physiology of the dairy cow was commenced in the summer of 1941 under the auspices of the Agricultural Research Council, and experiments have since been carried out involving 208 dairy cows. Iodinated casein, iodinated whole blood, and iodinated 'Ardein' have been fed to dairy cows, and all three have elicited increases in milk production.

In the early stages of the work, unpalatability of the iodinated proteins and iodine poisoning of the cow were severe limiting factors, and it proved impossible with proteins of low thyroidal activity to obtain a response without the onset of iodism, the symptoms appearing when more than 2·7–3·0 gm. of iodine were fed per day. More active preparations, however, have given more promising results.

'Ardein', a commercial preparation of the ground nut (*Arachis hypogæa*) rich in the globulin, arachin, has been iodinated under semi-commercial conditions, and the iodinated 'Ardein', containing 0·88 per cent acid-insoluble ('thyroxine') iodine has been used in two experiments. When 50 gm. of this material was fed, milk production increased 35 per cent, and fat

production 54 per cent. This was accompanied by an increase of 30 per cent in the resting pulse or heart-rate, 34 per cent in the resting respiration-rate, and a slight increase in the rectal temperature. In one of these experiments, no extra food was given to the cows to compensate for the increased metabolism, and, after seven weeks feeding with 50 gm. a day, the cows had lost 115 lb. of body weight or 9 per cent of their original weight. The shape of the weight-loss curve and the condition of the cows suggested that, in the latter stages of treatment, tissue protein was being mobilized to meet the increased energy requirement. Even after seven weeks treatment at such a high level, the clinical abnormalities shown by the cows were not so severe as was expected, and when treatment was stopped live-weight was rapidly regained. The subsequent history, performance, and postmortem appearance of animals subjected to such drastic treatment does not indicate that their health has been impaired.

Iodinated casein has been used in four experiments. It has been found that the response in milk production to a standard dose (30 gm.) of a highly thyroid-active preparation is dependent on the initial level of production of the cow. The response in pounds per day is greater the higher the initial yield ($r = +0{\cdot}7874$), but the percentage response declines with increasing initial yield ($r = -0{\cdot}4668$). As the main factor causing initial yield variation in these experiments was the stage of lactation of the cow, it is thought that response varies with the stage of lactation. This has been confirmed by experiments on the same cow at different lactation stages. The effect of lactation stage is interpreted as indicating a lower state of functional activity per unit of active mammary tissue during late lactation, and a larger amount of active mammary tissue in a higher state of functional activity in early lactation in the normal cow. It has not, however, proved possible to prolong, by iodinated casein feeding, milk production in cows approaching the end of their normal lactation period. Heifers and cows have responded equally well, no response differences have been found between cows at pasture and cows kept on winter rations, and Guernsey and Shorthorn cows have responded in a very similar manner.

It has been found that a dose of 15 gm. daily of iodinated casein increases milk production by approximately 16 per cent and 30 gm. daily by 33 per cent, indicating that the percentage response in milk production is directly proportionate to dosage within this range. The heart-rate increase and the percentage heart-rate increase, however, are nearly trebled by doubling the dosage, this probably indicating that at low dose-levels the increased metabolism is not reflected in an increase in the heart-rate. The relationship between the milk-yield response and the heart-rate response to iodinated proteins of different potencies confirms that at low milk-yield responses the heart-rate responses are proportionally lower than when the milk-yield response is high.

The galactopoietic potencies of iodinated proteins have been expressed in terms of the percentage increase in milk production per gram of iodinated protein fed. Potencies of 0·075 per cent for iodinated blood, 0·543 per cent for iodinated 'Ardein', and up to 1·096 per cent for iodinated casein have been found. There is a distinct, but not exact, relationship between the acid-insoluble ('thyroxine') iodine analysis of iodinated proteins and their galactopoietic potencies, but much better agreement with lactation response is shown by biological assays carried out with Xenopus tadpoles by Dr. A. S. Parkes.

Since the work was commenced, Reineke and Turner[10] have published the results of three-day feeding trials with dairy cows, using their own iodinated casein preparations. The results of these short-term trials also indicate that the milk production of cows can be stimulated by feeding iodinated casein.

The results reported above, together with much additional data on milk composition and the clinical effects of dosage, will be published later. Experiments are now in progress to find whether practical application of the results is possible, especially with regard to winter milk production.

My thanks are due to the Agricultural Research Council for grants in aid of this work.

K. L. BLAXTER.

Dairy Husbandry Department,
National Institute for
Research in Dairying,
Shinfield.
Nov. 20.

[1] Graham, W. R., jun., *J. Nutrition*, **1**, 407 (1934).
[2] Graham, W. R., jun., *Biochem. J.*, **28**, 1368 (1934).
[3] Folley, S. J., and White, P., *Proc. Roy. Soc.*, B, **120**, 346 (1936).
[4] Herman, H. A., Graham, W. R., jun., and Turner, C. W., *Univ. Missouri Res. Bull.*, 275 (1938).
[5] Morse, M., *J. Biol. Chem.*, **19**, 421 (1914).
[6] Ludwig, V., and von Mutzenbecher, P., *Z. physiol. Chem.*, **258**, 196 (1939).
[7] Harington, C. R., and Pitt Rivers, R. V., NATURE, **144**, 205 (1939).
[8] Report of the National Institute for Research in Dairying (1940), 35.
[9] Bottomley, A. C., and Folley, S. J., private communication (1941).
[10] Reineke, E. P., and Turner, C. W., *J. Dairy Sci.*, **25**, 393 (1942).

A Scientific Directory

IN recent months much has been said about the organization of science and, without prejudice to, or support for, any particular formula, there is one direction in which effect can be given in some measure to that aim, namely, in the provision for the British Commonwealth of a directory of scientists along the lines of "American Men of Science"[1]. Such a directory should be available in public libraries and research institutions and should serve to group together, in a manner hitherto entirely overlooked, those members of the community who conduct original investigations in the natural and exact sciences in any of the recognized branches. The concise style of entry, apart from the contentious practice of 'starring', adopted in "American Men of Science" is admirable for conveying the information that scientists have a right to expect to have regarding each other, and much would be gained in reducing the insularity felt by members of one branch *vis-à-vis* those of another.

The responsibility for the production of such a directory is beyond the purview of any of the scientific societies except perhaps the Royal Society, and it might not be too much to hope that the experience gained with the Central (Scientific) Register of the Ministry of Labour during the past few years could be made available for the project envisaged once stable conditions return at the end of the War.

JAMES WALKER.

National Institute for Medical Research,
London, N.W.3.

[1] "American Men of Science, A Biographical Directory". 1st Edn., 1906; 6th Edn., New York, 1938; 7th Edn., in preparation.

RESEARCH ITEMS

Obstructions to the Ascent of Salmon

INFORMATION as to obstructions in Newfoundland and Labrador rivers is summarized in a paper by A. A. Blair, Fisheries Research Laboratory, Newfoundland (Salmon Investigations. 1: Obstructions in Newfoundland and Labrador Rivers. Research Bulletin No. 12 (Fisheries). Department of Natural Resources, St. Johns. Newfoundland Government, 1943). In Labrador the type of obstruction is, in all cases, falls; in Newfoundland, mainly falls, but sometimes shoals and dams. It is suggested that improvements could be made in 9 out of 18 rivers in Labrador, and in 36 out of 81 rivers in Newfoundland. Ready accessibility to spawning grounds is a highly important factor in the maintenance of any stock of salmon, and these obstructions made ascent of salmon difficult or impossible. This collection of data is a valuable one, and will help much in the planning of improvements. Information about Labrador rivers was obtained directly from fur trappers, and about Newfoundland rivers from river wardens. Some of the more accessible obstructions were inspected personally, and of these information is given in greater detail.

A Protozoan Parasite of Freshwater Fish

A. DUNBAVIN BUTCHER has investigated the life-cycle of a ciliate parasite of the rainbow trout, brown trout and carp ("Observations on Some Phases of the Life Cycle of *Ichthyophthirius multifiliis* Fouquet, 1876, a Ciliate Protozoan Parasite of Fresh-Water Fish". *Australian Zoologist*, **10**, Part 2; 1943. Royal Zoological Society of New South Wales). There was a severe outbreak of this so-called 'white spot disease' at the trout hatcheries of the Ballarat Fish Acclimatisation Society in 1939 and 1940. Following this, the author has succeeded in elucidating the complete life-history of the parasite, in spite of the great difficulties incurred in bringing about natural infection of the fishes in aquaria. The total time for the completion of the life-cycle was found to be 13–16 days, which probably accounts for the periodicity of the epidemics. The parasite feeds on the whole cells of its host. The most likely hypothesis for the cause of the death of the fish is probably that the parasite is the source of a toxin which is fatal.

Heterostylism

Linum grandiflorum exhibits the phenomenon found by Darwin that pin-flowered plants are not usually fertilized by pin-flowers, nor thrum by thrum. D. Lewis (*Ann. Bot.*, N.S. **7**, 115; 1943) has discovered that differences in the osmotic pressure of styles and pollen of thrum- and pin-plants will account for the phenomenon associated with heterostyly. The stigma of Linum is placed on one side of the style and is permeable to water, whereas the epidermis of the style is relatively impermeable. On placing in water, the style curls with the stigmatic surface on the convex side. In 30–40 per cent cane sugar there is curling in the opposite direction. The author shows that the pin-style is isotonic with 18 per cent sucrose and the thrum-style with 12 per cent sucrose. Pin-pollen is isotonic with 3 per cent potassium nitrate and thrum-pollen with 5 per cent potassium nitrate. Thus pin-styles have high and pin-pollen low osmotic pressures relative to thrum-styles and pollen respectively. The discovery of Darwin that pin-styles pollinated with thrum-pollen become twisted is shown to result from the abstraction of water by the germinated thrum-pollen from pin-styles. The ratio of osmotic pressures in both legitimate pollinations is 4 : 1, but is 5 : 1 and 7 : 1 in the two illegitimate pollinations. This disparity partly explains the differences in behaviour in illegitimate pollinations—non-germination of pin-pollen and the bursting of thrum-pollen tubes. The author suggests that non-germination of pin-pollen cannot be accounted for, however, by simple osmotic relations, but that imbibition in the early stages of pollen germination is controlled by cell colloids.

Phylogeny and Basic Number in Crepis

THE genus Crepis provides valuable material for the analysis of speciation in relation to chromosome number and morphology. One of the most difficult questions was related to the presence of species with chromosome numbers less than the basic numbers of the genus, which are generally agreed to be 6 and 5 in Crepis. H. A. Tobgy (*J. Genetics*, **45**, 67–111; 1943) has made a thorough and valuable study of the relationships of *C. neglecta* ($n = 4$) and *C. fuliginosa* ($n = 3$). These two species are closely related and will hybridize and give some fertile hybrids. The taxonomic position indicates that *C. fuliginosa* is a derivative of *C. neglecta* or a very similar extinct form. Morphology of the chromosomes in these species, like many other Crepis species, enables each component arm to be identified and followed in the hybrids. Tobgy shows that the *A* and *D* chromosomes of both species form one complex, while the remaining three chromosomes, *B*, *C* from *neglecta* and *B* from *fuliginosa*, form another complex. The interrelationships of the arms of the chromosomes are fully determined, but from the point of view of the reduction in number the behaviour of the *BBC* complex is significant. The *Bn* and *Cn* chromosomes have undergone a reciprocal translocation to give *B* chromosome of *fuliginosa* and a chromosome with the *Cn* centromere. The latter has been lost, since it was genetically inert. The mechanism is somewhat similar to that which originated Dubinin's six-chromosome *D. melanogaster*, and to that suggested by Darlington for such chromosome reduction.

A Direct-Intensity Microphotometer

EXPERIENCE obtained at the Observatory of the University of Michigan in the operation of the ingenious microphotometer installed there has been described by its designers (*Astrophys. J.*, **98**, 43; 1943). The instrument has two plate carriers, on one of which is placed the photograph or spectrogram under examination, and on the other, which can be moved transversely, a calibration photograph, usually an optical wedge or wedge spectrum. This latter is kept in step with the other longitudinally while being moved transversely by automatic means in such a way that the densities of the two plates are always equal. This transverse motion is transferred by means of a cam and mirror to the final trace, which then reproduces directly the relative intensities in the photograph under examination. Line contours in absorption spectra can be reproduced to better than one per cent of the continuum for plate densities between 2·0 and 0·1, while the speed of operation is such that spectrophotometric comparison of two continuous spectra can be carried out at forty wave-

lengths over a range of 2500 A. in an hour and a half. The versatility of the instrument allows it to be used with 'standard spot' calibrations, as a transmission microphotometer, and as an isophotometer for use on faint diffuse objects. Many of these applications are illustrated by photographs and the corresponding tracings.

The Coronal Line Spectrum

A NOTE by P. Swings (*Astrophys. J.*, **98**, 116; 1943) gives an account of a paper by Edlén (*Z. Astrophys.*, **22**, 30; 1942) in which the Swedish spectroscopist publishes fuller details of his recent discovery of the origin of the emission lines in the solar corona. New identifications have been added to those already given (NATURE, **150**, 756; 1942): a line occasionally observed at 5536 A. is attributed to A X, and the line at 4359 A. is given, though not with certainty, as due to A XIV; while λ 7059 is identified as due to Fe XV and λ 5694 as perhaps due to Ca XV. The cosmic abundance of argon is not known, but neon is known to be of frequent occurrence, and the ground-term splitting in A X is accurately enough determined to make the identification of λ 5536 very probable. As regards the theory as a whole, the experimental evidence adduced by Edlén from his investigation of the extreme ultra-violet spectra of Fe X, Fe XI, Ca XII and Ca XIII, from his extrapolation of the ground-term splittings in iso-electronic sequences, and from his comparison of transition probabilities with observed intensities, is entirely convincing. There can remain no doubt that the problem of the origin of the coronal lines is now solved. Only four lines (λλ 3454, 4567, 3801 and 4311) remain unidentified, the last two being very faint; all the rest belong to forbidden transitions in the highly ionized atoms of iron, nickel, calcium and argon.

Magnetochemistry

IN the ninth Liversidge Lecture (*J. Chem. Soc.*, 328; 1943) S. Sugden discusses some recent applications of measurements of magnetic susceptibilities to the elucidation of structure. The modern quantum theory has greatly clarified the interpretation of magnetic data, but difficulties arise when quantitative comparisons are made between theory and experiment. In considering molecules the contribution of resonance to the susceptibility becomes significant, and for more complex molecules only semi-empirical methods are available. Prof. Sugden discussed several examples. The effect of temperature and the significance of orbital moments were dealt with, some cases in which the latter cannot be neglected being mentioned. The applications to co-ordination compounds were treated and some difficulties in the present state of the theory which are outstanding were pointed out. The lecture gives an interesting and balanced survey of the subject with which it deals.

Polymorphism of Arsenious Oxide

THE common crystalline form of arsenious oxide (As_4O_6) is octahedral, but a monoclinic form was discovered by Wöhler in 1832 and there is also a glassy amorphous form. The system was investigated by Rushton and Daniels in 1926 by measuring the vapour pressures of the two crystalline forms, estimating the melting points as 275° for the octahedral and 315° for the monoclinic. J. H. Schulman and W. C. Schumb (*J. Amer. Chem. Soc.*, **65**, 878; 1943) have made a further investigation of the system, including solubility, heats of transformation and X-ray and crystallographic measurements. They conclude that the monoclinic form is thermodynamically stable with respect to the more common octahedral form at temperatures as low as 2°, the transition temperature being approximately − 13°. Water vapour is effective in accelerating the transformation of octahedral to monoclinic As_4O_6 at 180°, whereas vapours of many other substances were found to be ineffective. The preparation of three new forms assumed by Smits and Beljaars (1931) was attempted without success.

Autoxidation of Ascorbic Acid

THE availability of ascorbic acid (vitamin C) is diminished through destruction by autoxidation. R. W. Peterson and J. H. Walton (*J. Amer. Chem. Soc.*, **65**, 1212; 1943) have shown that in the absence of copper very slow autoxidation occurs below $p\mathrm{H} = 8{\cdot}0$; it increases above this value, and in highly alkaline solution the rate is extremely high. In presence of copper the reaction occurs readily in both acid and alkaline solution. A marked autocatalysis was observed in the presence of copper. Hydrogen peroxide is among the products of the reaction. The inhibiting effects of many substances were determined. Except sodium citrate, all the appreciably effective substances contained one or more amino groups and one or more acid groups. In general, an increase in the number of acid groups or the number of amino groups increased the inhibiting effect. None of the compounds inhibited the reaction in the absence of copper.

Spectra of New Stars

AN important publication by Dean McLaughlin (*Pub. Obs. Univ. Mich.*, **8**, No. 12; 1942) draws a generalized picture of the spectroscopic development of a typical nova, and suggests a physical interpretation of the observations which is new in some respects. A thorough survey of the course of seven bright novæ enables the author to compare the corresponding stages in their development in a way hitherto impossible to the reader of the many previous descriptive papers, owing to the absence of an agreed terminology. Five systems of absorption lines and seven of emission lines are distinguished, many of them existing concurrently. Fluctuations in the light curve are correlated with spectral changes and with velocity changes; and an attempt is made to reconcile the various temperature determinations. It is significant that the variations of temperature found are almost exactly the opposite of what would be expected were the outburst due to a simple heating and subsequent cooling of the surface of a star. The changes are interpreted as due to a continuous emission of stellar material from a thin superficial layer at a rate which varies much as the light emission does, reaching a maximum just before light-maximum and dropping sharply soon after. The velocity of the ejection is not necessarily related to this rate, and indeed reaches its maximum long afterwards. The older theory of the successive emission of discrete shells is abandoned in favour of one in better accord with present ideas of what constitutes the photosphere of a nova. The question of the source of the energy released below the surface of the star is left open.

THE SPANISH IRON AND STEEL INDUSTRY

IN a recent issue of *Dyna* (Revista de la Asociacion Nacional de Ingenieros Industriales de España) a paper by Señor F. Millan on "Spanish Metallurgy since the National Movement", read at Barcelona somewhat earlier, is given in full. It is confined entirely to iron and steel and steel manufactures.

After the War of 1914–18, production of Spanish iron and steel gradually increased until, in 1929, that of pig iron was about 722,000 tons and of steel just over 1,000,000 tons. It declined, of course, rather drastically during the revolution, but in recent years has recovered somewhat, though not up to the 1929 level. In 1942 pig iron was about 500,000 and steel 650,000 tons. The most serious difficulties in the way of real progress are lack of good metallurgical coke and scrap, to which must now be added a lower grade of native ore.

Until recently Spain had been noted for the high quality of its iron ores, with up to 60–70 per cent metallic iron content; but the average percentage appears now to be in the neighbourhood of 40 per cent, and it has larger contents of sulphur and phosphorus. In 1940 output of ore was nearly 3,000,000 tons, but domestic consumption was only just over 1,000,000 tons and exports almost negligible, so that large stocks accumulated at the mines, many of which had to close down at least for a time, and production during the first half of 1941 was only 797,000 tons. Before the revolution more than 80 per cent of the output had been exported to England, Germany and Belgium, the red hæmatites being particularly in demand. The chief mines are in Vizcaya, Santander, Granada, Teruel, etc. An interesting account of some of the magnetic iron ores of El Teuler and one or two other places has been given by H. Quiring (*Z. prakt. Geologie*, **46** and **47**; 1938–39). Geological estimates of the remaining reserves, after allowing for 325 million tons mined, are roughly 700 million tons. So far as Vizcaya, the chief mining centre, is concerned, the bulk of the remaining ores are carbonates with only about 30 per cent hæmatite. The carbonates are rather high in sulphur (up to 1·7 per cent) and the hæmatites in silica. The iron content of the latter, too, is only about 40 per cent. This all adds to the amount of coke required in smelting, of which there is already insufficient supply.

Although the manganese ore deposits are fairly considerable in places, such as those in Huelva and Teruel, output is very low. Thus in 1940 it was only 6,850 tons of ore, to be increased, it was hoped, to 10,000 tons in 1943. Metallic manganese content ranges from 37 per cent in Huelva to 53 per cent in Buferrera.

Spain has also considerable supplies of native coal, but not very much of it appears to be of the right kind for metallurgical coke production. At the Geological Congress at Toronto it was estimated that Spain's coal reserves were some 8,768 million tons, of which three fourths would be bituminous. Some of the principal coal centres are in Asturias, Teruel, Leon, and Palencia. The Spanish coal output in 1929 was 7½ million tons, and 2 million tons were imported together with nearly 300,000 tons of coke. Native coal production has increased somewhat in recent years, up to about 10 million tons in 1942, despite shortage of equipment, such as explosives and timber; and owing to the practical impossibility of importing good coke from Great Britain and Germany, native coal had to be used for the purpose, to the extent of 500,000–600,000 tons of coke. Much of this native-made coke, however, has a high ash content, up to 16 per cent or more, as compared with only 8 per cent in good English coke.

Yet another difficulty, to which reference has been already made, is the shortage of scrap for steel-making. Attempts have been made to overcome these difficulties—lack of coke and of scrap—by means of the Krupp-Renn process, introduced into Germany about 1933–34, and fully described by Johannsen (*Tech. Mitt. Krupp Forschungsber.*, and also *Stahl u. Eisen*, 1934 and 1939). This method, in which huge rotary furnaces are used, something like cement kilns, is claimed to be particularly suitable for low-grade ores and can be used with almost any kind of fuel, including powdered coal or lignite. The ore is first reduced to a pasty condition, and then at a temperature below its melting point is converted into low-carbon compact lumps embedded in slag, from which the lumps are separated by a crushing process.

In his later paper (Sept. 1939), Johannsen included not only direct production of steel but also the application of the method to the reduction of non-ferrous ores. At that time it appeared there were about eighteen Renn furnaces in operation, but not more than half a dozen were in Germany; most of the others had been sent to Japan, where the process is more largely used than in Germany itself, probably due to the low grade of ore with which Japan has for the most part to be contented. According to latest reports, Japan is at present using eleven of these furnaces, of which four are in Manchukuo and seven in Japan and Korea. It is stated that six more were recently under construction in Manchukuo.

So far as Spain is concerned, progress in this matter has been rather slow. Apart from a concession granted to the Soc. Gen. de Electro Metalurgia to instal one of these plants in Aviles, Asturias, for an output of 30,000 tons of steel a year (to be doubled later) little else has been done, although the Instituto Nacional de Industria has sent a special mission to Germany to study the Renn process. According to Señor Millan, a trial plant may be put up in Vizcaya.

Señor Millan seems to be of the opinion that, if it is seriously intended to make Spain self-supporting in regard to iron and steel production, the best hopes lie in the direction of the so-called sintering (*sinterizacion*) methods, now so largely used in Germany with low-grade ores—to the extent of 35 million tons of ore in 1943; and he deals with these possibilities at some length, including the proposed adoption of the Sturzelberg and Norwegian Tysland hole methods.

Señor Millan includes a review of some of the principal Spanish producers of iron and steel, of which the chief is the well-known Soc. Altos Hornos de Vizcaya, with a capital of 250 million pesetas, and a maximum total capacity of nearly 700,000 tons pig iron a year. It has its own coal mines, coking plant, by-product recovery plant, rolling mills, etc. Several other fairly large companies are noted, and an interesting point about many of them is the increasing attention being given to manufactured steel, for which purpose many new rolling mills and other technical equipment have been installed in recent years.

SOVIET WAR-TIME SURGERY

WHEN four British surgeons flew to the U.S.S.R. and stayed there for three weeks, they were given a great welcome and were taken not only to medical institutions in Moscow but also up the line so far forward as Vyazma to study the field and mobile hospitals. They learned that the Soviet surgeons have no new fundamental principles to teach us and do not need to learn any from us; their principles are the same as ours and differ only in the details of their application[1]. But young Russian surgeons would benefit from a study of our best hospital practice and our young surgeons would learn much from the Russian clinics. The methods of some Russian surgeons are notable. Prof. Yudin, for example, apart from his remarkable operation for replacement of the obstructed œsophagus by the jejunum, differs somewhat in his use of the skin-tight plaster for the treatment of war wounds. This method has been attributed to the Soviet surgeon Pirogoff, who, when he was short of splints in the Crimean War, cut out sailcloth to the patterns required and dipped these in plaster. This closed-plaster method was developed by Trueta in the Spanish Civil War. The closed-plaster method has been also attributed to Trueta himself, to Winnett-Orr in the United States, to Mettita in Italy and to Ollier in France.

While neither Soviet nor European anæsthetic practice is so good as it is in Great Britain or the United States, the Soviet system of blood transfusion was found by our visiting surgeons to be beyond criticism and it is done on a huge scale[2]. In one Moscow institution alone 500–800 donors are bled every day and 90 per cent of them are women. Donors get extra rations and also pay, but four-fifths of the money is returned for war purposes. There is never any lack of blood; it is flown to the front and has even been flown to Soviet wounded behind the German lines.

Another valuable feature of the Soviet Army Medical Service is the practice of sorting out all types of case in clearing stations five miles behind the firing line. This is done by an experienced surgeon and the cases are then sent to specialist hospitals, where they are treated by specialists in the kind of injury from which they are suffering. But before they are sent away they receive immediate treatment from young members of surgical teams, who are trained to give the treatment which the senior specialists expect them to have had. The clearing stations immediately behind the front are well equipped and each has a series of special units complete in itself. Perhaps this system—and the tough Russian constitution—has helped the Russians to return 70 per cent of their wounded to the firing line. Some of its features were shown in a film given to the Royal College of Surgeons last October[4]. This film was made two years ago. It showed the rescue of wounded by sledge, the method of giving each patient a bath, a shave and a general clean-up, and some of the methods of rehabilitation of function after injuries. It also showed some of the wards, which are less formal than those in British military and other hospitals.

The Russian military nurse awoke the admiration of the visiting surgeons. She not only does her job very well but also helps to build the hospital in which she works, cutting down trees, squaring up timber, making the frames of windows and doors and digging foundations. The British surgeons were impressed by her skill in camouflage. On one occasion they stopped in what appeared to be a forest; it turned out to be the entrance to a hospital containing a thousand beds. Some of the buildings had been built round the trees, which projected through the roofs. One is reminded of a certain medical unit at Makina, Basra, during the War of 1914–18, at which the reed huts were built round the palm trees in this way; the palm trunks made useful wardrobes.

The medical service of the U.S.S.R. is becoming a woman's service, 90 per cent of the doctors now under training being women. They take a five-year course, while a nurse's course has been reduced from three years to two.

The British surgeons were also much impressed by the emergency medical service in Moscow, the organization of which recalls the organization of the National Fire Service in Britain. Moscow is divided into areas, a map of which enables telephone operators detailed for night duty to send, within a few minutes, in response to a call for medical help, a well-equipped ambulance, with a doctor, a nurse and an orderly, to the house requiring them. The central operator uses a device which illuminates on the map of the city the street from which the call comes and also the nearest ambulance depot, with which she then communicates. There would appear to be no reason why cities in Britain should not be supplied with this valuable service.

Soviet military ophthalmology has recently been described by Prof. Kolen, head of the Novosibirsk Eye Clinic[5]. Evidently it is obtaining good results in its treatment of the dangerous and distressing injuries which involve not only the all-important eye, but also the neighbouring organs and the face in general. Wound-healing by the transplantation of tissues is also widely practised[6]. Dead tissues treated with chloraclyde are used as an aid in healing up fresh and granulating wounds, and regeneration is stimulated with emulsions of embryonal tissue obtained from guinea pigs and used in castor oil as a liquid base.

G. LAPAGE.

[1] *Lancet*, 198 (Aug. 14, 1943).
[2] *Lancet*, 485 (Oct. 16, 1943).
[3] *Brit. Med. J.*, 206 (Aug. 14, 1943).
[4] *Lancet*, 487 (Oct. 16, 1943).
[5] *Lancet*, 804 (June 26, 1943).
[6] *Science*, **97**, 162 (1943).

UTILIZATION OF BAMBOOS IN INDIA

AS is well known, in tropical and subtropical countries where the bamboo in one or more of its many genera and species flourishes, man, as represented by the local population, has over very long periods of time made extensive use of it—in fact, from house construction down to the provision of the woman's household utensils and even part of the clothing. The bamboo has probably been as serviceable in an all-round fashion to man as any other single vegetable product. It is of interest, therefore, to follow its more modern uses by civilized man who has long discarded its former utilitarian ones.

In a Utilisation brochure issued by the Forest Research Institute, Dehra Dun (*Indian For. Rec.*, For. Res. Pub., Dehra Dun, 1943), V. D. Limaye describes some investigations into "Bamboo Nails, their Manufacture and Holding Power". The investigation

was commenced owing to the fact that wire nails had become very difficult to obtain in India, while the demand for packing cases, not least for army requirements, had increased enormously. Experiments were carried out to see how bamboo nails compared in holding power and other qualities with wire nails. The results of the tests are given; and sketches of large-scale production of bamboo nails are included and the process of manufacture described.

Truly India is a fortunate country when her carefully supervised forest wealth enables her to confront one difficulty after another in times of dire stress through the work of her research officers. "It has been found", says the author, "that glued bamboo nails have a greater holding power than plain iron nails under a steady pull. But when shocks and transportation hazards are met with, their holding power diminishes". A small percentage of iron nails in a packing case is, therefore, necessary, especially for fixing the battens by clinching. It was found by actual tests that if 25 per cent iron nails and 75 per cent bamboo nails are used, a strong and serviceable box results, with a very considerable saving in costs of manufacture.

Another use of the bamboo has been found in the manufacture of pill or ointment boxes. Due to a shortage of metal, various substitutes have had to be used in the construction of containers; thus plywood containers have already been mentioned in NATURE (*Ind. For. Leaf.* 24 and 26). In Leaflet 39 (1943) Sultan Mohammed discusses the method of making from bamboo small pill and ointment boxes. Details of manufacture are given including some information on suitable coatings and linings. It is said that a fairly competent turner will find no difficulty in making these boxes with the aid of a lathe and ordinary tools. The description is of interest: "A bamboo container consists of a short length of bamboo (according to size of container required) which forms the walls of the body and lid of the container. The top and the bottom are made of thin three plywood and are provided with a locking device so that, if the top becomes loose due to climatic changes, the lid will still be held tight. The container is usually coated or painted, both inside and outside, with the object of retarding the absorption of moisture by sealing the pores of the bamboo, and to give a smooth clean finish."

THE SCIENCE OF TOMATO GROWING

THE Cheshunt Experimental and Research Station has devoted its energies during war-time wholly to the elucidation of problems connected with food crops. Reports of investigations on the tomato occupy most of the twenty-eighth annual report, for 1942, of the Station (from the director, Dr. W. F. Bewley, The Nursery and Market Garden Industries' Development Society, Ltd., Turner's Hill, Cheshunt, Herts, 1943). Trials of the value of muriate of potash as against sulphate of potash resulted in a small, though scarcely significant, increase of crop in favour of the sulphate. No harmful foliage effects were observed when muriate was added, and it would seem that widespread doubts about the suitability of muriate of potash for the indoor tomato crop are now dispelled.

Much research has been devoted to diseases and pests of the tomato. Two varieties, Manx Marvel and Riverside, showed significant resistance to the wilt fungus *Verticillium albo-atrum*. Tomato stem-rot caused by the fungus *Didymella lycopersici* caused widespread damage in 1942 to plants growing in the greenhouse and in the open. The disease appears to be carried from crop to crop on wire supports and strings, and may be controlled by suitable methods of hygiene. Experiments have also been made with fungicides as soil treatment, or applied as sprays and dusts to the plant, or as a protection of the 'collar', where infection normally occurs in greenhouse tomatoes.

Control of the wireworm pest by trapping with carrot bait gave rather disappointing results, and the elimination of these larvæ still remains one of the outstanding problems of pest control. Other negative results were obtained with sprays containing tartar-emetic and glycerine, advocated in the United States against the red-spider mite, and with potassium iodide solution for the prevention of damage by the root-knot eelworm.

Tomatoes in sand culture exhibited clear-cut symptoms when deprived of boron, manganese and magnesium. Omission of boron and magnesium from the culture solution produced marked stunting, and boron deficiency caused a leaf scorch similar to that sometimes associated with acute potassium starvation. Lack of magnesium induced a withering of the tips of leaflets, whereas the absence of manganese brought about a mottling of the leaf with uniform yellow specks. The report contains details of these and other investigations in the form of short papers by the authors of each subject for research.

HYDROGEN EXCHANGE REACTIONS

IN two papers (*J. Chem. Soc.*, **361**, 367; 1943) H. V. A. Briscoe and co-workers describe the results of experiments on the interchange of hydrogen isotopes with complex salts, ammines of cobalt, and platinum and palladium being studied. The hydrogen of $[Co(NH_3)_6]\,Cl_3$ and $[Co\ en_3]\,Cl_3$ (en = ethylenediamine) undergoes isotope exchange with heavy water (D_2O) in solutions, the interchange following a unimolecular law with a rate inversely proportional to the hydrogen ion concentration but practically independent of the ammine concentration or its deuterium content. The exchange mechanism is explained by assuming that the metal ammine group $M—NH_3$ can ionize as an acid: $M—NH_3 = M—NH_2' + H^+$, this being parallel to the ionization of aquo-ammines, which form hydroxo-ammines. There is some evidence that the case of acid dissociation runs parallel with the stability of the ammines. The reaction mechanism is very fully discussed in the papers on the basis of the kinetics.

The rate of interchange of hydrogen isotopes with ammines of different metals decreases in the order Co > Pt > Pd and runs parallel to the complex ions. In the case of $[Pd(NH_3)_4]\,Cl_2$ the interchange mechanism is complex; in addition to the acid dissociation mechanism, it reacts in acid solution by reversible dissociation of ammonia from the complex. This points to a continuous gradation between the two extreme types of ammonia complexes represented by the stable metal ammines of the $[Co(NH_3)_6]\,Cl_3$

type and the unstable ammoniates of bivalent cobalt, nickel, copper, etc. The function of the nitrogen atom of the ammonia molecules as a centre of co-ordination has perhaps not been sufficiently emphasized in the past, and its tendency to assume a configuration similar to that of the ammonium ion in the stable compounds, which then dissociate as substituted ammonium salts, should apparently also be taken into account.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Tuesday, December 28

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. E. N. da C. Andrade, F.R.S.: "Vibrations and Waves", 1: "Vibrations".*

Thursday, December 30

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. E. N. da C. Andrade, F.R.S.: "Vibrations and Waves", 2: "Wave Properties in General".*

Friday, December 31

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. A. J. Philpot: "Paints and Protective Finishes for Metals".

Saturday, January 1

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. E. N. da C. Andrade, F.R.S.: "Vibrations and Waves", 3: "Sound Waves".*

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TECHNICIAN FOR THE VETERINARY LABORATORY—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (December 28).

MASTER to be responsible for the teaching of MATHEMATICS at the Bristol Junior Technical School—The Chief Education Officer, 2 Cecil Road, Clifton, Bristol 8 (December 29).

ASSISTANT LECTURER IN THE MINING DEPARTMENT—The Principal, County Mining and Technical School, Nuneaton, Warwickshire (December 31).

PRINCIPAL (temporary) of the Bridgend Mining and Technical Institute and Junior Technical Schools—The Director of Education, County Hall, Cardiff (January 3).

ASSISTANT MASTER to teach MATHEMATICS in the Day School—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham, Essex (January 3).

MASTER or MISTRESS (temporary) for SCIENCE, including ELEMENTARY BIOLOGY—The Clerk to the Governors, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17 (January 3).

ASSISTANT (part-time) IN SPEECH TRAINING in the Department of Education—The Registrar, The University, Manchester 13 (January 10).

SCIENCE MASTER, mainly for CHEMISTRY, up to University Scholarship standard, at the City of London School—The Town Clerk, 55–61 Moorgate, London, E.C.2 (January 12).

CHAIR OF CHEMISTRY—The Principal, University College of Wales, Aberystwyth (January 15).

REGIUS PROFESSOR OF ZOOLOGY at Glasgow University—The Private Secretary, Scottish Office, Fielden House, 10 Great College Street, London, S.W.1 (January 17).

DEMONSTRATOR IN ANATOMY (male)—The Secretary, Guy's Hospital Medical School, London Bridge, London, S.E.1.

LABORATORY STEWARD for the Chemistry Department—The Principal, Coventry Technical College, Coventry.

ASSISTANT INSPECTORS I and II (covering Groups A and B) for posts (London and Provinces) in a Government Department. For Group A posts sound technical and practical training in Mechanical Engineering is required, preferably in Heavy or Marine Engineering or in Modern Engineering Production Methods; for Group B posts sound technical and practical training and experience in Mechanical Engineering is required, with special knowledge of Foundry Practice, the Nut and Bolt Industry, the Metallurgy of Ferrous and Non-Ferrous Metals, or the Armour Plate Industry—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1952A, and grade and group for which application is being made).

WORKS ENGINEER (Order No. 275) with good experience in Plant Maintenance (including Electrical) and Lay-outs of New Projects required; a METAL SHOPS SUPERINTENDENT (Order No. 262), with Machine Shop experience essential and Coppersmith experience desirable; an ASSISTANT CHIEF OF PRODUCTION CONTROL (Order No. 274), must be thoroughly conversant with Engineering Procedure and Operation of Works Documents, with good administrative ability and experience in dealing with large staff—The Ministry of Labour and National Service, A.O., 16 Westwood Road, Southampton (quoting appropriate Order No.).

PLANTATION ASSISTANTS in the Cameroons under the Custodian of Enemy Property, Nigeria—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. F.1888).

LECTURER (temporary) in the DEPARTMENT of BUILDING and STRUCTURAL ENGINEERING—The Principal, Central Technical College, Suffolk Street, Birmingham 1.

CHIEF PLANNING ENGINEER at a well-known Airframe Manufacturing Concern in the London area—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1951XA).

GRADUATE ASSISTANT MASTER to teach GENERAL SCIENCE with MATHEMATICS in Day Technical School and Evening Institute—The Principal, Technical Institute, 28 Beckenham Road, Beckenham, Kent.

ASSISTANT LECTURER to teach ENGINEERING SUBJECTS, including SCIENCE, MATHEMATICS and DRAWING to day and evening students—The Principal, Forest of Dean Mining and Technical School, Cinderford, Gloucestershire.

ASSISTANT MASTER or MISTRESS to teach GEOGRAPHY, and an ASSISTANT MASTER FOR ENGINEERING SUBJECTS, at the Burton-upon-Trent Technical Institute and Junior Technical School—The Secretary and Director of Education, Education Offices, Guild Street, Burton-upon-Trent.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Geological Survey of Great Britain. Wartime Pamphlet No. 13: Limestones of Scotland, Area 8: Orkney and Shetland. By D. Haldane: with Analyses by H. G. M. Hardie. Pp. 13. (London: Geological Survey and Museum.) 9*d*. [1111

Imperial Bureau of Animal Breeding and Genetics. Gestation Periods: a Table and Bibliography. Compiled by J. H. Kenneth. Pp. 23. (Edinburgh and London: Oliver and Boyd, Ltd.) 2*s*. [1111

Iron and Steel Institute. Special Report No. 29: Review of the Work of the Joint Research Committees 1924–1943 of the Iron and Steel Institute and the British Iron and Steel Federation. Pp. viii+176. (London: Iron and Steel Institute.) [1111

Transactions of the Royal Society of Edinburgh. Vol. 61, Part 1, No. 3: Cytological Studies in the Genus Solanum, 1: Wild and Native Cultivated "Diploid" Potatoes. By Dr. H. C. Choudhuri. Pp. 113–136. 3*s*. Vol. 61, Part 1, No. 4: Inheritance of Resistance to Two Strains of Blight (*Phytophthora infestans* de Bary) in Potatoes. By Dr. William Black. Pp. 137–148. 1*s*. 6*d*. (Edinburgh and London: Oliver and Boyd, Ltd.) 1*s*. 6*d*. [1211

Transactions of the Royal Society of Edinburgh. Vol. 61, Part 1, No. 1: The Genus Primula, Section Farinosae. By Sir W. Wright Smith and Dr. H. R. Fletcher. Pp. 69. (Edinburgh and London: Oliver and Boyd, Ltd.) 8*s*. 6*d*. [1911

Other Countries

Indian Forest Bulletin. Utilisation (New Series), No. 120: Studies in Permeability. Part 1: A Preliminary Note on the Permeability of Wood and other Materials to Air. By D. Narayanamurti and A. Purushotham. Pp. 16+3 plates. 6 annas; 7*d*. Indian Forest Leaflet. Utilisation, No. 40: Studies on Adhesives, Part 4: Further Note on Prolamin Adhesives. By D. Narayanamurti and V. Ranganathan. Pp. ii+14. 6 annas; 9*d*. Utilisation, No. 43: Air Condenser Kiln suitable for the Seasoning of Cooperage Woods and Packing Case Timbers. By M. A. Rehman. Pp. ii+6+1 plate. 6 annas; 9*d*. Utilisation, No. 45: Preliminary Studies on Improved Wood, Part 2: Laminated Wood. By D. Narayanamurti and Kartar Singh. Pp. 8+6 plates. 6 annas; 9*d*. (Dehra Dun: Forest Research Institute.) [1410

Smithsonian Institution. War Background Studies, No. 13: Alaska, America's Continental Frontier Outpost. By Ernest P. Walker. (Publication 3733.) Pp. iv+57+21 plates. (Washington, D.C.: Smithsonian Institution.) [1910

Bulletin of the American Museum of Natural History. Vol. 81, Art. 4: Fossil Lizards of Mongolia. By Charles W. Gilmore. Pp. 361–384+plate 52. (New York: American Museum of Natural History.) [1910

Academia das Ciências de Lisboa: Bibliotecas de Altos Estudos. Relações científicas entre Portugal e a Grã-Bretanha. Por H. Amorim Ferreira. Pp. viii+76. (Lisboa: Academia das Ciências.) [1910

Carnegie Institution of Washington: Department of Terrestrial Magnetism. Scientific Results of Cruise VII of the *Carnegie* during 1928–1929 under command of Captain J. P. Ault. Biology, 3: Studies in the Morphology, Taxonomy and Ecology of the Peridiniales. By Herbert W. Graham. (Publication 542.) Pp. vii+129. 1.50 dollars. Meteorology, 1: Meteorological Results of Cruise VII of the *Carnegie*, 1928–1929. By Woodrow C. Jacobs and Katherine B. Clarke. (Publication 544.) Pp. v+168. 1.50 dollars. Meteorology, 2: Upper-Wind Observations and Results obtained on Cruise VII of the *Carnegie*. By Andrew Thomson. (Publication 547.) Pp. vii+93. 75 cents. (Washington, D.C.: Smithsonian Institution.) [2010

Proceedings of the American Philosophical Society. Vol. 87, No. 1 (July 14, 1943): The Early History of Science and Learning in America: Papers read before the American Philosophical Society, Midwinter and Autumn Meetings, 1942. Pp. iii+120. (Philadelphia: American Philosophical Society.) [2010

Brooklyn Botanic Garden Record. Vol. 32, No. 3: The Medicinal Plant Garden of the Brooklyn Botanic Garden. (Guide No. 16.) Pp. 165–210. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) 25 cents. [2210